Engineering and Mining Journal

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ONE-EASY-STEP

At the Inspiration Consolidated Copper Company, there was started on April 4th a contest between two 8-ft. Marcy ball mills and two 8-ft. ball mills of another type. It is now concluded and the competitive ball mills are being replaced by Marcy mills. Results show that the competitive ball mill has less than one-half the capacity and uses more than 30% more horsepower per ton than the Marcy Mill when the same feed is crushed to the same degree of fineness.

The Marcy 8-ft. mill requires 225 H.P. The competitive mill, had it been able to do the same amount of work as the Marcy, would have required 319 H.P.

The above results are published knowing they will be of great value to those contemplating the purchase of machinery for fine grinding in the preparation of ores for flotation or concentration.

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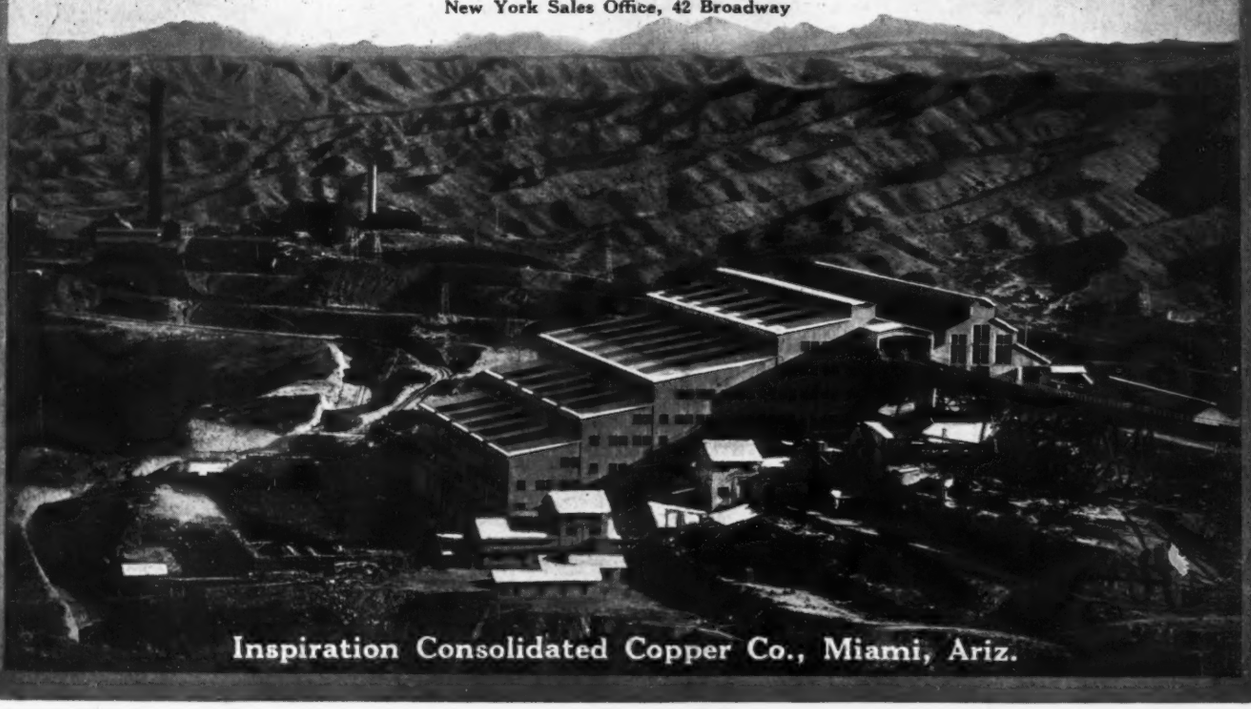

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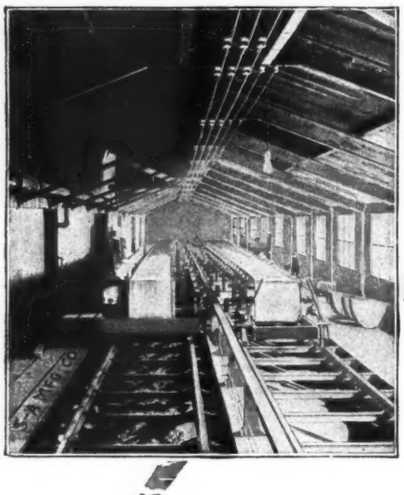

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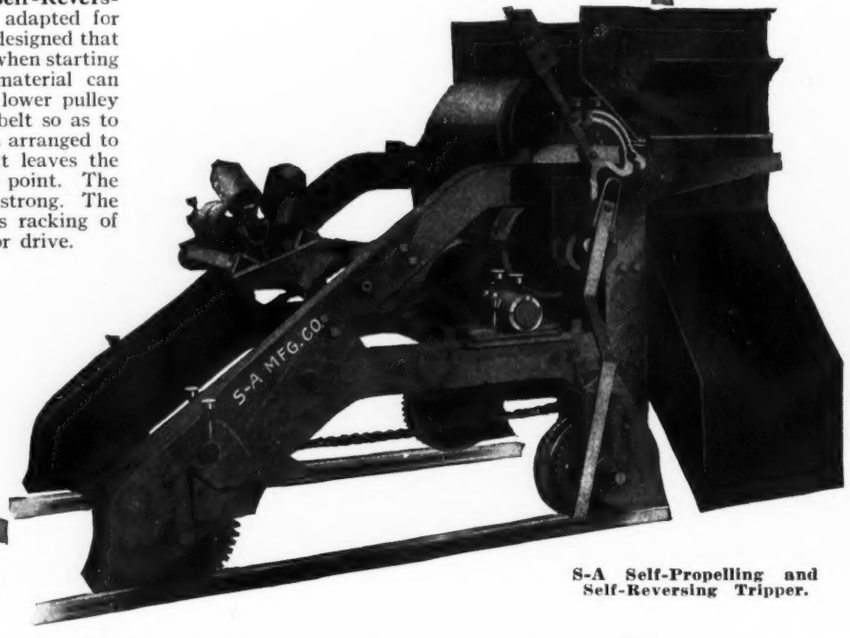

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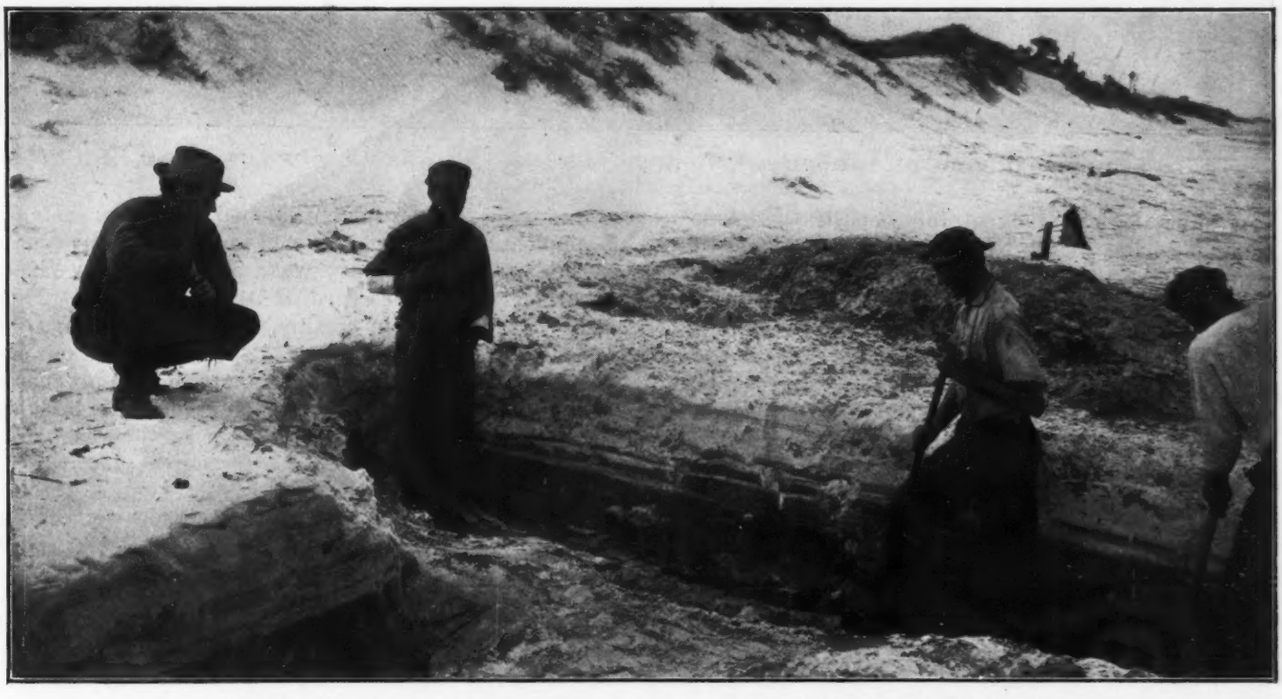
A Florida Rare-Mineral Deposit

By DONALD M. LIDDELL
Consulting Metallurgical Engineer, New York

Ilmenite, zircon, rutile and monazite sand are found in a beach sand near Jacksonville, Fla. The deposit is being worked by a suction dredge, the sand being table-concentrated and the concentrate dried. Ilmenite is then removed by magnets, and the tailings from the magnetic concentrator are again tabled to separate the monazite sand, zircon and rutile.

ON THE East Coast of Florida, a little below the mouth of the St. Johns River, lies a beach-sand deposit from which most of the present production of ilmenite and monazite sand in the United States is being derived. The discovery of this deposit is due to H. H. Buckman and G. A. Pritchard, its present owners and workers, and was the outcome of an exhaustive investigation of the resources of Florida in fireclays, glass sand, infusorial earths, etc., originally undertaken for some of their friends. The presence of ilmenite in a sample of sand was observed, and study of the deposit convinced them it was present in commercial quantity. However, to make sure they were not going into a business that was capable of unlimited competition they made a survey of the beach sands from Savannah to the southern tip of Florida and up the west coast as far as Tampa, where the beach becomes calcareous, and it was believed that no further investigation was necessary. The deposit taken up by them was the only one found.

It lies between the mouths of the St. Johns River and North River, at Jacksonville and St. Augustine respectively. The beach is a little over 22 miles long, of which about 10 appears to be workable, and of which 17 miles is held by Buckman & Pritchard. To the north the resorts of Atlantic Beach and Pablo Beach appear to mark the limits of workability, as the surface improvements are worth more than the underlying minerals; to the south the sand gradually grows poorer until only traces of the valuable minerals are met with in the low-lying sand spit that terminates the beach, from which one looks across to Anastasia Island and the towers of St. Augustine.



AN EXCAVATION ON THE FLORIDA BEACH, SHOWING THE FRIENDSHIP VEIN

The coast at the Buckman & Pritchard property consists of a gently sloping beach, about 520 ft. wide at low tide, a series of dunes about 200 ft. wide and rising to a

mean height of about 12 ft. above high water, behind which is a valley paralleling the coast. This valley is, for about 13 miles, occupied by the Guano River, which flows south to the North River. The Guano rises a little to the south of the Buckman & Pritchard mill, which is itself about 4¾ miles south of Pablo Beach. To the north the valley forms part of the "hammock," the local name for a bad lands of sand, scrub palmetto and snakes, that two or three miles inland give way to pine woods. The deposit appears to be a natural concentration by wave action, and the maximum richness occurs near the mill.

The workable portions of the deposit are the dunes themselves, which appear to be payable for 50 ft. below mean high-water level, and a concentration along their base, known as the "Friendship vein." This is about 70 ft. wide and has an average thickness of about 9 ft., besides which about 8 ft. of lower grade below this seems to be workable. This concentration is very remarkable. Sand taken from any portion of the property (in the 15 miles of greatest richness) will show the ilmenite readily by either blowing or washing, but in the Friendship bed the black stands out in the material as mined, as shown in the accompanying illustration.

Of the rich Friendship bed there seems to be about 1,025,000 tons, and of the low-grade beach sand about 31,750,000 tons clearly profitable and perhaps 10,000,000 tons more that may prove workable. The fineness of the deposit is astonishing. Of 2500 lb. taken as a sample, about 4 oz. of it, chiefly shells, would not pass a 12-mesh screen. From small amounts of material tested the results are about the same on a 40-mesh screen.

The fineness of the deposit renders mining the simple problem of taking up the beach and dunes with a suction dredge, putting the sand over a concentrating table and using the tailings to fill up the valley spoken of as lying behind the dunes. Ultimately it is planned to put the roughing tables on the dredge and convey only the concentrates to the mill, but at the time of my visit the roughing tables were in the mill and everything was sent to it.

At present the capacity of the dredge is not great enough to give the mill sufficient tonnage to turn out the amount of ilmenite being shipped, so mining is being conducted on the Friendship bed and the material sent to the mill by freight car. The dredge is kept in a pond, partly because the richer material is back from the ocean, partly to avoid losing the dredge or the connecting pipes in a storm. This pond, as well as the mill, is supplied from an artesian well that gives about 2,800,000 gal. of water per day when allowed to flow freely under its natural pressure of 31 lb. per sq.in. This, it may be remarked in passing, is much larger than the famous wells of New Zealand. The water is, like most of the Florida East Coast waters, strongly impregnated with sulphureted hydrogen, but on standing it becomes palatable as well as good for boiler use.

A GENERAL VIEW OF THE BEACH AND APPROACH AND A CLOSER VIEW OF THE PLANT

A mineralogical study of this deposit was made by D. H. Newland, of the New York State Geological Survey. He states that in order of abundance the minerals occur as follows: Quartz, ilmenite, zircon, epidote, rutile, staurolite, monazite, cyanite, spinel, garnet, corundum, tourmaline, pyroxene, amphibole, feldspar, xenotime, pyrochlore and magnetite. Platinum is present, but neither gold nor silver has been identified. The "epidote" seems open to question, as the mineral apparently so identified by Newland appears to contain about 15% of titanium. However, this is a minor matter.

About 33,000,000 Tons Workable Material

The deposit has also been examined by Prof. Charles E. Locke, of Boston, who ran several mill tests on large quantities of the sand. His average results on the Friendship bed were as follows: Ilmenite, 5.43%; rutile, 0.59; monazite, 0.08; zircon, 1.96%. On the dune sand he obtained: Ilmenite, 1.065%; rutile, 0.12; monazite, 0.015, and zircon, 0.46%.

In regard to the results on the dune sand, however, the per cent. of ilmenite is low according both to operating results obtained by Buckman & Pritchard and to a mill run made by me. In justice to Professor Locke I was told that he was more interested in the monazite content and did not try to make high ilmenite recovery:

Wet Concentration Followed by Magnets

As stated, the first process is a simple wet concentration. The concentrates are then completely dried. Up to date driers of the type used for foundry sand have been employed, but a Ruggles drier is being installed. The dried concentrates are then put through Ding's magnetic concentrators working at 15 amp., thus removing the ilmenite. The magnetic tailings are then put back over the tables (five-deck tables are to be used in the future for this).

On this second tabling the display of colors in the bands on the deck is very pretty. Along the top edge of the table is a dark-brown streak of some unknown mineral, carrying about 1½ oz. Pt per ton of streak, then comes a dirty yellow band of monazite sand, a white band of zircon, a red one of rutile, and finally a broad

greenish-yellow belt of staurolite and epidote (?) fading off into a chemical miscellany in which white silica predominates.

So far the commercial products are ilmenite (the concentrate carrying about 52% Ti), zircon and monazite sand, although rutile and garnet should easily be produced commercially. The zircon is at present being ground before shipment, an interesting feature of this being that toward the last of the grinding operation the zircon suddenly swells greatly, disengaging large quantities of helium as it does so.

The products are shipped out and supplies received over a private railroad about 4½ miles long, connecting with the Florida East Coast Ry. near Pablo.

As to the origin of the deposit, there seems to be no evident explanation. The cerium-thorium ratio of the monazite sand is unlike that of any of the known Carolina monazites, and also unlike the known South American sands. We probably must postulate an ancient river with its mouth near the site of the present mill, deriving this material from pegmatite in some mountains to the north, but it is just about as easy as it is to accept this,

DREDGE FOR RECOVERING THE MINERAL

to believe the explanation that it is part of the coast of the lost Atlantis.

Along this line, however, a portion of an abstract from the *Journal* of the Society of Chemical Industry of an article in the *Bulletin* of the Imperial Institute, p. 321, 1916, may be of interest:

> The work of the Mineral Survey of Ceylon during 1911-15 was devoted mainly to searching for thorium-bearing minerals on the west and south coasts and in various inland districts. Along the coast, most of which is bordered by shallow water, "nambu"—a natural concentrate of heavy minerals (mainly ilmenite and magnesite associated with monazite, garnet, zircon, rutile, etc.) varying from a film to several feet in thickness and from a foot to several yards in width—was found at many points. From Colombo to Dutch Bay Point and from Puttalam to Kudremalai the monazite content of these deposits was generally under 3%; but nambus containing 7, 9 and 12% resepectively were found at the mouth of the Maha Oya, near Marawila, and near Welaboda, while a similar deposit near Kudremalai contained 22%. Between Colombo and Hambantota the nambus were black or red according as ilmeite or garnet predominated; although nearly always present in the former, monazite was seldom found in the latter. . . . On the Moon Plains in the Nuwara Eliya district, the source of a nambu rich in monazite, xenotime, corundum and zircon (the first two containing uranium) was traced to a pegmatite dike the richer parts of which were found to contain 310 grams of monazite per metric ton. An acid rock of the granulite type, containing a small proportion (20 grams per ton) of monazite, was also found in this district; and it is considered probable that the granular monazite so widely distributed in the alluvial gravels of Ceylon is derived from similar rocks of the granulite series and not from the pegmatite intrusions.

The question of origin of this Florida deposit will probably be an interesting source of discussion for some time. In conclusion, I wish to thank the Chapin-Buckman Publicity Co., of Jacksonville, Fla., for furnishing the photographs from which the accompanying illustrations are made.

The Pittsburg-Dolores Mill

BY E. J. SCHRADER

Manager for the Pittsburg-Dolores Mining Co.

During the 18 months of operation of the Pittsburg-Dolores mill, at Rockland, Nev., there was milled 23,326 tons of rock from the mine, 2052 tons from dumps and 1890 tons of tailings, having a total value of about $230,370, the value being in the gold content of the ore. During that time the quantity of tailings discharged had an average value per ton of $0.814. The extraction was 90.4%. The average cost of milling was $2.75, but in this connection it is well to note that the costs were reduced from $3.20, during first six months, to $2.28 during last six months, notwithstanding continual increase in the price of supplies. This was brought about by mechanical improvements and metallurgical saving. It was also caused by the increase in the ratio of gold to silver in the ore, which enables us to make a better extraction and also materially decreases the period of treatment. Bullion is now worth $3.52 per oz. In January, 1916, we were receiving only $2.15 per oz. Only a small portion of the increase is caused by the present high value of silver.

The average ore milled per day was 49 tons. This was increased to 60 during last year. Assaying, office and general expenses averaged 73c. per ton. Supplies increased in cost from 12%, for some minor items, to as high as 220% during the period. The increase is estimated at 68c. per ton for the period over the prices that prevailed when operations were started in the summer of 1915.

At present two sets of rolls are used and the treatment of a larger tonnage with satisfactory results being impossible with these, the purchase of a ball mill to replace rolls, screens and elevator is recommended. It is estimated that a saving of $1200 per month can be made on the basis of 80 tons milled per day, and even better results may be obtained by careful work.

Molybdenite in New South Wales

The Sydney *Daily Sun* reports the discovery of a large deposit of molybdenite ore near Bathurst, New South Wales. A company with capital of $900,000 has been registered in New Zealand to exploit the mines.

The article points out that the ore has been tested by drilling and that on every part of the property the deposit has been tapped. It claims that the average molybdenum in the ore is 1.7%. The company proposes to put up a mill capable of treating 40 tons of ore a day, and to use electric drills, which would indicate a possible market for American manufacturers.

Drill Bits and Drill Steel for Metal Mining

By GEORGE H. GILMAN*

Explanations and further details of manner of sharpening and of tempering drill bits. Description of method of severing rock particles from the mass; reaming qualities of bits; angle of cutting edge; width, thickness and taper of the wings, with some suggestions to operators of drilling machines.

THE various letters and communications that have been received by me from mining men in different parts of the country, relative to my article of the same title which was published in the May 12 issue of the *Journal* indicate that there exists in the minds of some readers a misconception of the facts that I attempted to set forth especially with respect to the essential qualifications of the rock-drill bit; and on the strength of requests for more detailed information on several phases of the subject that were generalized upon in the article referred to, kindly permit me to elaborate on several points that apparently were not made sufficiently clear.

The essential qualifications of the rock-drill bit, regardless of the conditions under which it is used, are as follows:

Distribution of Work Throughout the Entire Length of the Cutting Edge

It is desirable to have the bit so made that the load is evenly distributed throughout the entire length of the cutting edge. In other words, the shape of the cutting edge and the manner in which it is applied to the work should be such that when dulled by natural wear, the flattened surface will be approximately uniform throughout the entire length of the cutting edge. As an illustration, if we were to so proportion a single-cutting-edge chisel or bull bit as to have it meet this requirement, it would assume a scroll shape corresponding to the letter S (as shown by Fig. 1*A*) with the length of the cutting edge per unit of distance from the axis of the bit increasing with the square of the diameter. Such a bit is obviously impractical, but by making a bit with four wings instead of two, it is practical to secure the desired result (with a shape as shown by Fig. 3*A*) without increasing the total length of the cutting edge but slightly more than that of a drill bit having a length of cutting edge double the diameter of the drill hole, which has been found to be desirable for average conditions of ground.

It should be so made that the cutting edge may be tempered uniformly throughout its entire length by a practical method. This may be accomplished by equalizing the area of conductivity throughout the entire length of the cutting edge, to insure a uniform distribution of the heat from the massive portion of the bit rearward of the cutting edge, for drawing the temper. In the previous article the double-arc bit (Fig. 12) and the chisel bull bit (Fig. 5) illustrate typical examples of drill bits possessing this qualification. The cross-bit (Fig. 8) is of the type which provides for a very uneven distribution of heat from the massive portion to the cutting edge.

The bit should be so formed that the depressions made by the cutting edge as it is rotated axially in the drill hole cross each other at a slight angle, thus causing the rock to be broken in diamond-shaped chunks from the bottom of the drill hole, instead of chipping or crushing it radially, which is the result secured with the cross, chisel, rose and other types of radial-cutting-edge bits. The methods of fracturing the rock with the double-chisel bit (Fig. 10), the "H" bit (Fig. 11), the double-cross bit (Fig. 9) and the double-arc bit (Fig. 12), as shown by the diagrammatic drawings, indicate the manner by which this may be accomplished.

Method of Severing Rock Particles from Mass

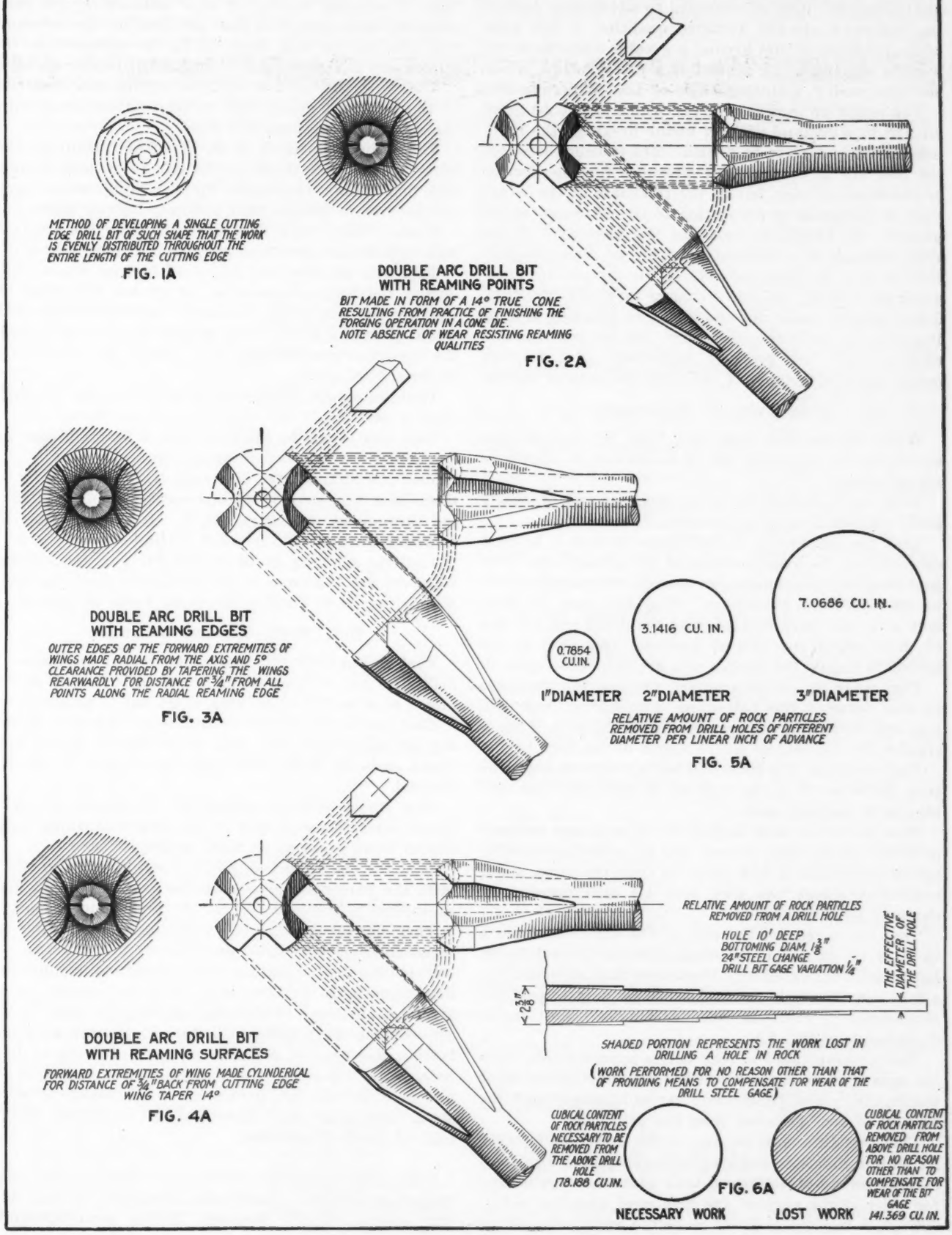
The extremeties of the wings of the bit adjacent the terminals of the cutting edge should be formed with either a reaming edge or a reaming surface. Under no circumstances is a reaming point desirable.

A reaming point is secured when a rock-drill bit is made in the form of a true cone, resulting from the practice of finishing the forging operation in a cone die of the drill sharpener (see Fig. 2*A*). A reaming edge is secured when the outer edge of the forward extremities of the wings are made radial from the axis of the bit and clearance is provided by tapering the wings rearwardly at a fixed angle from all points along the radial reaming edge (see Fig. 3*A*). A reaming surface is secured when the outer edges of the forward extremities of the wings are made radial from the axis for a fixed distance rearward of the cutting edge (see Fig. 4*A*).

A reaming surface may be employed to advantage only when the rock conditions are such that the natural transverse whipping action of the drill bit when struck by the hammer will cause it to cut a clearance for itself. The effect of this action is emphasized in ground of a granular nature in which the rock particles are readily disintegrated from the side walls by the natural crushing or chattering action of the bit, under which conditions it will cut a round hole of greater diameter than the maximum diameter of the bit. Inasmuch as such reaming qualities, dependent upon the area of the surface in contact, provide for wear-resisting qualities, it is advisable to employ as great a reaming surface as the conditions of the ground will permit without imposing undue duty upon the rotating mechanism of the drill.

For all conditions of ground where a reaming surface is not permissible, it is recommended that the reaming qualities of the bit be determined by a reaming edge the clearance angle of which should be as slight as the conditions of the rock will stand. A clearance angle for the reaming edge of 5° should be employed in preference to an angle of 7° unless the greater clearance is essential to secure the required freedom of rotation, for the smaller the amount of reaming clearance the less will be the reduction in gage diameter by wear of the bit in service.

*With Sullivan Machinery Co., Claremont, N. H.


METHOD OF DEVELOPING A SINGLE CUTTING EDGE DRILL BIT OF SUCH SHAPE THAT THE WORK IS EVENLY DISTRIBUTED THROUGHOUT THE ENTIRE LENGTH OF THE CUTTING EDGE
FIG. 1A
DOUBLE ARC DRILL BIT WITH REAMING POINTS
BIT MADE IN FORM OF A 14° TRUE CONE RESULTING FROM PRACTICE OF FINISHING THE FORGING OPERATION IN A CONE DIE. NOTE ABSENCE OF WEAR RESISTING REAMING QUALITIES
FIG. 2A
DOUBLE ARC DRILL BIT WITH REAMING EDGES
OUTER EDGES OF THE FORWARD EXTREMITIES OF WINGS MADE RADIAL FROM THE AXIS AND 5° CLEARANCE PROVIDED BY TAPERING THE WINGS REARWARDLY FOR DISTANCE OF 3/4" FROM ALL POINTS ALONG THE RADIAL REAMING EDGE
FIG. 3A
0.7854 CU.IN.
3.1416 CU. IN.
7.0686 CU. IN.
1" DIAMETER
2" DIAMETER
3" DIAMETER
RELATIVE AMOUNT OF ROCK PARTICLES REMOVED FROM DRILL HOLES OF DIFFERENT DIAMETER PER LINEAR INCH OF ADVANCE
FIG. 5A
DOUBLE ARC DRILL BIT WITH REAMING SURFACES
FORWARD EXTREMITIES OF WING MADE CYLINDERICAL FOR DISTANCE OF 3/4" BACK FROM CUTTING EDGE WING TAPER 14°
FIG. 4A
RELATIVE AMOUNT OF ROCK PARTICLES REMOVED FROM A DRILL HOLE
HOLE 10' DEEP
BOTTOMING DIAM. 1 3/8"
24" STEEL CHANGE
DRILL BIT GAGE VARIATION 1/4"
THE EFFECTIVE DIAMETER OF THE DRILL HOLE
SHADED PORTION REPRESENTS THE WORK LOST IN DRILLING A HOLE IN ROCK
(WORK PERFORMED FOR NO REASON OTHER THAN THAT OF PROVIDING MEANS TO COMPENSATE FOR WEAR OF THE DRILL STEEL GAGE)
CUBICAL CONTENT OF ROCK PARTICLES NECESSARY TO BE REMOVED FROM THE ABOVE DRILL HOLE 178.188 CU.IN.
CUBICAL CONTENT OF ROCK PARTICLES REMOVED FROM ABOVE DRILL HOLE FOR NO REASON OTHER THAN TO COMPENSATE FOR WEAR OF THE BIT GAGE 141.369 CU. IN.
NECESSARY WORK
LOST WORK
FIG. 6A

DRILL STEEL AND DRILL BITS FOR METAL MINES

For average conditions of ground a cutting-edge angle of 90° is recommended. For soft ground a more acute angle than 90° may be employed to advantage, depending somewhat on the abrasive qualities of the rock, while for hard, brittle ground a greater angle than 90° may be employed. In ground of a flinty nature, which shatters readily, a cutting angle of 120° is permissible.

The width or thickness of the wings should be great enough to withstand without undue breakage the hardness of the ground to be drilled. The thicker the wings the less will be the available clearance for the ejection of the rock cuttings, but as the thickness of the wings may be increased in proportion to the hardness of the ground, the clearance space for the ejectment of the rock cuttings will decrease inversely in direct proportion, so that the requirements of the ground are automatically met by making a change in either direction. The degree of taper for the wings in blending the bit into the steel body should be such that the reaming and cutting edges are properly supported. For average conditions a wing taper of 14° gives the desired results.

Best Types of Equipment

When determining the best type of rock-drilling equipment for any fixed set of conditions, it should be remembered

That the rock-drill bit is the business end of nearly every rock-excavating proposition.

That the logical way to drill holes in rock is by first determining the requirements of the ground and then providing drilling equipment to meet the requirements to the very best advantage. That this may be done only after you have decided upon the depth and the size of drill hole at its bottom diameter that will be required to handle the burden you are to impose upon it.

That when this is determined, the less the variation in size between the bottoming diameter of the drill hole and its mouth, the greater will be the rate of penetration throughout the entire length of the drill hole.

That the duty of a rock-drill bit is to disintegrate the rock particles from the bottom of the drill hole and also from the side walls.

That there is a wide distinction to be drawn between drilling a round hole in rock and in removing a corresponding amount of rock particles from the mass, under conditions where the rock may be disintegrated by chipping to a free face.

That by increasing the size of the drill hole from 1 in. to 2 in. diameter, the work that the rock-drill bit has to do is increased four times, and that when drilling a 3-in. diameter hole the drill bit has a duty to perform nine times as great as when drilling a hole 1 in. in diameter (see Fig. 5*A*).

That drilling speed in rock varies approximately with the square of the diameter of the drill hole; or in other words, the rate of penetration varies inversely with the amount of rock removed from the drill hole.

That the difference in area of the drill hole between its bottom diameter and its mouth represents work performed for no other reason than that of compensating for wear of the gage of the drill steel (see Fig. 6*A*).

That it is possible to so make the reaming qualities of a rock-drill bit that wear will be slight and that under present-day conditions, if a $\frac{1}{4}$-in. variation in gage is employed it is practical to reduce this to $\frac{1}{32}$ in. variation.

That under average present-day conditions rock drills weighing 150 lb. are employed for no other reason than that of securing a force of blow sufficient to cut rock with the large-gage bits that are used as starters, and that the use of drill steel of $1\frac{1}{4}$ in. diameter is required only to support the cutting end of large-gage bits.

That with the hammer drill the absorption of energy of the blow in transmission to the rock increases with the weight of the rock-drill steel.

That vibratory shock is an important factor in the many causes that result in fatigue of rock-drill steel and that within reasonable limits a light, rapid blow produces more fatigue that a slower heavier blow.

That a heavy, slow blow does not wear the gage of rock-drill bits in service as rapidly as a light, fast blow.

That you put life into rock-drill bits by hammering during the forging operation, which has the effect of refining the grain and removing forging strains that would otherwise exist. That when tempering drill steel, the one important essential is to quench the heated bits at the critical point.

That automatic quenching and tempering of drill steel is desirable.

That bits should be equipped with a reaming edge or a reaming surface—*never* with a reaming point.

That the cutting edge of a rock-drill bit should be so made that the work is approximately evenly distributed throughout its entire length. It is impossible to secure this result with a radial cutting-edge bit.

That the reaming qualities, the angle of the cutting edge and the thickness of the wings are the only variables required to adapt a bit to all kinds of ground.

Dull Steel Induces Breakage

That dulled drill bits are conducive to breakage of drill steel and drill parts, as breakage is largely determined by a lack of cushioning effect due to penetration.

That inspection of the finished steel before it leaves the smithshop and that such inspection of the bit and shank ends be made with ring limit gages is recommended.

That under average present-day conditions an additional expenditure of $10 in the drill-sharpening shop should mean a saving of $200 underground.

That the one important point to strive for is to minimize the personal equation in the smithshop and also as applied to the operation of the drill underground.

That proper care in the selection and working of rock-drill steel will under present standard practice result in the use of lighter rock drills and mountings, dispensing with the "two-man" rock drill except under special conditions; lighter and smaller air hose; lower air consumption, smaller drill steel, higher rate of penetration, less wear of drill bits per unit of depth of drill hole, better cleaning of drill holes due to reduction in size of drill hole, less drill steel, less breakage of drill steel, fewer stuck drill steels and less ill temper on the part of the drill operator.

Steel Production of Austria-Hungary in 1916 was: Bessemer, 343,714; openhearth, 2,893,409; crucible, 34,033; electric, 47,247; forgings, 18,204; total, 3,336,607 metric tons, which was an increase of 650,381 tons over 1915. Of the total Austria produced 2,501,070 tons; Hungary, 813,433 tons; Bosnia, 22,104 tons.

North American Flotation Plants

The accompanying list covers, as nearly as possible the plants in North America making use of flotation in some form and upon some scale. It is expected that it will be found incomplete, since it has been very difficult to find all those using the process, and there are probably some duplications, due to the various sources of information.

Some of the firms listed were using flotation only experimentally, and it follows that some of them may have ceased its use after a period of investigation. The list is, however, representative of considerable work, and it is to be hoped that it will prove of some value.

FLOTATION PLANTS OF NORTH AMERICA

Name of Company	Situation of Works
Alaska Gold Mines Co.	Juneau, Alaska
Alhambra Mining Co., Ltd.	Office, Empire State Building, Spokane, Wash.
Allgrove Mining and Milling Co.	Nederland, Boulder Co., Colo.
Amalgamated Pioche Mines and Smelters Corporation	Pioche, Nev.
American Metal Producing Co.	Black Hawk, Colo.
American Smelting and Refining Co.	Denver, Colo.
Argo Reduction and Ore Purchasing Co.	Idaho Springs, Colo.
American Zinc, Lead and Smelting Co.	Mascot, Tenn.
Algonkian Mines Co.	Groom Creek, Ariz.
Amador Mine Co.	Iron Mountain, Mont.
Antelope Star Mining Co.	Milford, Utah
Afterthought Copper Co.	Ingot, Shasta Co., Calif.
Ajax Gold Mining Co.	Victor, Colo.
Alaska Copper Corporation	Strelna, Alaska
American Molybdenum Co.	Kingman, Ariz.
Apex Copper Co.	Hayman, Park Co., Colo.
Arizona Butte Mines Co.	Kingman, Ariz.
Arizona Empire Copper Mines Co.	Parker, Ariz.
Arizona Hercules Copper Co.	Ray, Ariz.
Arizona Mine	Humboldt, Ariz.
Ash Peak Mines Co.	Duncan, Greenlee Co., Ariz.
Aspen Mines	Silverton, Colo.
Atlanta Mines Co.	Goldfield, Nev.
American Ore Flotation Co.	Silverton, Colo.
Amparo Mining Co.	Etzatlan, Jalisco, Mexico
Anaconda Copper Mining Co.	Anaconda, Mont.
Arizona Copper Co., Ltd.	Clifton, Ariz.
Atlas Mining and Milling Co.	Sneffles, Colo.
Atwater, M. W.	Basin, Mont.
Butte & Superior Mining Co.	Butte, Mont.
Buster Consolidated Mines Co.	Jarbidge, Elko Co., Nev.
Butte-Duluth Mining Co.	Butte, Mont.
Bingham-New Haven Copper and Gold Mining Co.	Bingham Canyon, Salt Lake Co., Utah
Borealis Cons. Mines Co.	Auburn, Placer Co., Calif.
Broderick Mining Co.	Freeland, Colo.
Black Cloud Mining Co.	Salina, Boulder Co., Colo.
Boise-Rochester Mining Co.	Atlanta, Elmore Co., Idaho
Bon Ton Mining and Leasing Co.	Pitkin, Colo.
Bully Hill Copper Mining and Smelting Co.	Winthrop, Shasta Co., Calif.
Bunker Hill Mines Co.	Tombstone, Ariz.
Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho
Battle Mountain Mining and Development Co.	Battle Mountain, Nev.
Ben Harrison Mines	Whitney, Ore.
Big Four Exploration Co.	Atkinson, Utah
Big Giant Leasing Co.	Silverton, Colo.
Bingham Mines Co.	Bingham, Utah
Bluestone Mining and Smelting Co.	Yerington, Lyon Co., Nev.
Bluebird Mining and Refining Co.	Office, 501 C. of C. Building, Spokane, Wash.
Boston & Corbin Mining Co.	Corbin, Jefferson Co., Mont.
Bradshaw Reduction Co.	Crown King, Ariz.
Brooklyn Mining Co.	Maxville, Mont.
Beaver Consolidated Mining Co.	Cobalt, Ont., Canada
British Columbia Copper Co., Ltd.	Greenwood, B.C., Canada
Britannia Mining and Smelting Co., Ltd.	Britannia Beach, B. C., Canada
Broadwater Mills Co.	Park City, Utah
Brockmann & Co.	Magdalena District, Sonora, Mexico
Butte Central Mining and Milling Co.	Butte, Mont.
Canada Copper Corp., Ltd.	Greenwood, B.C., Canada
Castle Copper Co.	Prescott, Ariz.
Consolidated Copper Mines Co.	Eureka, Juab Co., Utah
Caldo Mining Co.	Frisco, Utah
Chino Copper Co.	Hurley, Grant Co., N. M.
Cash Mine Co.	Prescott, Ariz.
Contact Copper Co.	Contact, Nev.
Copper Hill Mining Co.	La Plata, Colo.
Columbus Mines Co.	La Plata, Colo.
Caledonia Mining Co.	Wardner, Shoshone Co., Idaho
Chicago-Boston Mining Co.	Wallace, Idaho
Commack Mining Co.	Breckenridge, Colo.
Comet Mining and Milling Co.	Whitefish, Flathead Co., Mont.
Consolidated Nevada-Utah Corp.	Pioche, Lincoln Co., Nev.
Consolidated Mines and Reduction Co.	412 E. Bennett Ave., Cripple Creek, Colo.
Copper Giant Mine	Jerome, Yavapai Co., Ariz.
Copper Queen Consolidated Mining Co.	Douglas, Ariz.
Copper Queen Gold Mining Co.	Stoddard, Ariz.
Curlew Mine	Victor, Ravalli Co., Mont.
Calumet & Arizona Mining Co.	Warren, Ariz.
Caribou Mines and Mills Co.	Cardinal, Boulder Co., Colo.
Carlisle Mines Co.	Steeple Rock, Grant Co., N. M.
C. & O. Mining and Milling Co.	Pinos Altos, Grant Co., N. M.
Cia. Mineral Chontalpan y Anexas, S. A.	Mexico
Cœur d'Alene Antimony Mining Co.	Kellogg, Idaho
Chicago Copper Refining Co.	Red Bluff, Tehama Co., Calif.
Childers Leasing Co.	Midvale, Utah
Chloride Mines Co.	Chloride, Ariz.
Colorado Central Mining Co.	Georgetown, Colo.
Consolidated Copper Mines Co.	Kimberly, Nev., and Ely, Nev.
C. O. D. Consolidated Mining Co.	Goldfield, Nev.
Calumet & Jerome Copper Co.	Jerome, Yavapai Co., Ariz.
Conigas Mines, Ltd.	Thorold, Ont., Canada
Cork-Province Mines	Kaslo, B. C., Canada
Calaveras Copper Co.	Copperopolis, Calif.
Calumet & Hecla Mining Co.	Calumet, Mich.
Ceylon Co.	Mount Olive, Ala.
Chichagoff Mining Co.	Chichagoff Isl., Alaska
Clark, Senator W. A.	Butte, Mont.
Consolidated Arizona Smelting Co.	Mayer, Yavapai Co., Ariz.
Consolidated Interstate-Callahan Mining Co.	Wallace, Idaho
Consolidated Mining and Smelting Co. of Canada, Ltd.	Trail, B. C., Canada
Cuba Copper Co.	El Cobre, Santiago de Cuba
Cusi Mining Co.	Cusihuiriachic, Chihuahua, Mexico
Duquesne Mining and Reduction Co.	Duquesne, Ariz.
Daly West Mining Co.	Park City, Summit Co., Utah
Davis Daly Copper Co.	Butte, Mont.
Daly-Judge Extension Mining Co.	Park City, Utah
Diamondfield Black Butte Mining Co.	Goldfield, Esmeralda Co., Nev.
Dunkirk & Poverty Mines	Prescott, Ariz.
Duplex Mining Co.	Searchlight, Clark Co., Nev.
Detroit Copper Mining Co. of Arizona	Morenci, Ariz.
Denver Mining and Milling Co.	Wortman, Colo.

Name of Company	Situation of Works
Dominion Reduction Co., Ltd.	Cobalt, Ont., Canada
Desloge Consolidated Lead Co.	Desloge, St. Francois Co., Mo.
Doe Run Lead Co.	St. Francois Co., Mo.
Dutch Sweeney Mining Co.	Quartz, Tuolumne Co., Calif.
Ducktown Sulphur, Copper and Iron Co., Ltd.	Isabella, Polk Co., Tenn.
Ellamar Mining Co.	Ellamar, Alaska
Elkhart Mines Co.	Chloride, Ariz.
Emma Mine	Fierro, Grant Co., N. M.
Empire Zinc Co. of Colorado	Tucson, Ariz.
Encinitas Copper Co.	Encinitas, Calif.
Estelle Mining Co.	Keeler, Calif.
Evergreen Mines Co.	Apex, Gilpin Co., Colo.
East Butte Copper Mining Co.	Butte, Silverbow Co., Mont.
Eighty-Five Mining Co.	Lordsburg, N. M.
Empire Mining Co.	Cananea, Sonora, Mexico
Empire Zinc Co. of Colorado	Arizona, Colo.
Eustis Mining Co.	Eustis, Que., Canada
Ely Copperfield Associates	West Fairlee, Vt.
Engels Copper Mining Co.	Keddie, Plumas Co., Calif.
Federal Lead Co.	Flat River, Mo.
Federal Mining and Smelting Co.	Wallace, Idaho
Florence Goldfield Mining Co.	Goldfield, Nev.
Forbestown Consolidated Gold Mines	Forbestown, Calif.
Frisco Tunnel Co.	Office, 241 Oliver Building, Pittsburgh, Penn.
Florence Silver Mining Co.	Ainsworth, B.C., Canada
Flint Mines, Ltd.	Owyhee Co., Idaho
Gold Hill Mining Co.	Jerseyville, Ill.
Golconda Consolidated Mines Co.	Golconda, Ariz.
Gold Crown Mining and Reduction Co.	Ouray, Colo.
Golden Age Mining Co.	Office, 1st National Bank Bldg., Denver, Colo.
Gold Hunter Mining and Smelting Co.	Mullan, Idaho
Gibson Copper Co.	Bellevue, Gila Co., Ariz.
Gold Bank Mine	Forbestown, Calif.
Gold King Mine	Gladstone, Colo.
Great Bend Mine	Goldfield, Nev.
Green Mountain Mine	Howardsville, Colo.
Genesee Mine	Ironton, Colo.
Giroux Consolidated Mines Co.	Kimberly, Nev.
Gold Ore Mining Co.	Oatman, Ariz.
Granby Consolidated Mining, Smelting and Power Co., Ltd.	Phœnix, Boundary District, B. C., Canada
Goldfield Consolidated Mines Co.	Goldfield, Esmeralda Co., Nev.
Greene-Cananea Copper Co.	Cananea, Sonora, Mexico
Hammond Mining Co.	Excelsior, Wash.
Hecla Consolidated Mines Co.	Hecla, Larmie Co., Wyo.
Home Lode Mining Co.	Silver City, S. D.
Hunter Mining Co.	Mullan, Idaho
Hudson Mill	Idaho Springs, Colo.
Hercules Mining Co.	Burke, Idaho
H. E. M. Mining Co.	Wallace, Idaho
Hahn's Peak Gold Mining and Milling Co.	Hahn's Peak, Routt Co., Colo.
Hamlet Mining and Milling Co.	Howardsville, San Juan Co., Colo.
Hecla Mining Co.	Wallace, Idaho
Highland Surprise Consolidated Mining Co.	Kellogg, Idaho
Hill City Tungsten Production Co.	Hill City, S. D.
Homestead Iron Dyke Mines Co., Inc.	Homestead, Baker Co., Ore.
Horn Silver Mine Co.	Frisco, Beaver Co., Utah
Humboldt Mines Co.	Telluride, Colo.
Hypotheek Mining and Milling Co.	Kingston, Shoshone Co., Idaho
Humphreys Mill	Office, Suite 217, Coronado Building, Denver, Colo.
Highland Valley Mining and Development Co.	Ashcroft, B. C., Canada
Ironside Mine	Butte, Mont.
Ideal Copper Mining Co.	Luning, Nev.
Iowa-Tiger Mining Co.	Silverton, Colo.

Name of Company	Situation of Works
Iron City Mill	Gilpin Co., Colo.
Inter-Mountain Copper Mining Co.	Iron Mountain, Mont.
Idora Mining Co., Ltd.	Wallace, Idaho
International Nickel Co.	Sudbury, Ont., Canada
International Molybdenum Co.	Renfrew, Ont., Canada
Inspiration Consolidated Copper Co.	Miami, Ariz.
Judge Mining and Smelting Co.	Park City, Utah
Jumbo Extension Mining Co.	Goldfield, Nev.
Kennedy Mining and Milling Co.	Jackson, Amador Co., Calif.
Keystone Consolidated Mining Co.	Park City, Utah
Kennecott Copper Corporation	Kennecott, Alaska
Keystone Mining and Reduction Co.	Chloride, Ariz.
Keystone Copper Mining Co.	Johnson, Cochise Co., Ariz.
Kittimac Mine and Mill Co.	Silverton, Colo.
King Edward Mines Co.	Cobalt, Ont., Canada
Liberty Bell Gold Mine Co.	Telluride, San Miguel Co., Colo.
Lincoln Mine	Crown King, Ariz.
Last Chance Mine	Cable Cove, Baker Co., Ore.
Lost Packer Mining Co.	Ivers, Custer Co., Idaho
Leviathan Mines Co.	Kingman, Ariz.
Little Giant Gold Mining and Milling Co.	Lawson, Colo.
La Blanca Mines Co.	Pachuca, Hidalgo, Mex.
Mary Murphy Gold Mining Co.	Rawley, Colo.
Mascot Mining and Milling Co.	Office, 212 Brooks Arcade, Salt Lake City, Utah
Miami Copper Co.	Miami, Gila Co., Ariz.
Mickey-Breene Mines	Silverton, Colo.
Midvale Minerals Co.	Midvale, Utah
Montana Illinois Copper Mining Co.	Jefferson Island, Madison Co., Mont.
Mammoth Copper Mining Co.	Milford, Utah
Marsh Mines Consolidated Co.	Wallace, Idaho
McKeen Mine	Callahan, Calif.
Mears & Wilfley Mining and Milling Co.	Silverton, Colo.
Mid-Colorado Mines Co.	Georgetown, Colo.
Mine La Motte Co.	La Motte, Mo.
Miller Mountain Mining Co.	Candelaria, Nev.
Mogollon Mines Co.	Mogollon, Socorro Co., N. M.
Morning Mine	Mullan, Idaho
Magma Copper Co.	Superior, Pinal Co., Ariz.
Marion Mine and Mills Co.	Rye, Colo.
Mayflower Mine	Silverton, Colo.
Missouri Cobalt Co.	Fredericktown, Mo.
Moho Mining Co.	Sodaville, Nev.
Monitor-Belmont Mining Co.	Belmont, Nye Co., Nev.
Montezuma Mines and Mills Co.	Montezuma, Colo.
Moctezuma Copper Co.	Nacozari, Moctezuma, Sonora, Mexico
McAlpine Mines Co.	Coulterville, Mariposa Co., Calif.
McKinley-Darragh Savage Mines Co.	Cobalt, Ont., Canada
Mineral Recovery Co.	Joplin, Mo.
Mond Nickel Co., Ltd.	Victoria Mines, Algoma, Ont., Canada
Mountain Copper Co., Ltd.	Keswick, Shasta Co., Calif.
McDonald & Noble	Leadville, Colo.
North Pole Mine	Bourne, Ore.
National Copper Mining Co.	Mullan, Idaho
Nevada Consolidated Copper Co.	Ruth, White Pine Co., Nev.
Nevada Metals Extraction Co.	Goldfield, Nev.
North Star Triumph Mining Co.	Haily, Idaho
N. W. Mines Consolidated Co.	Maxville, Mont.
Nevada Copper Mining, Milling and Power Co.	Contact, Elko Co., Nev.
Nevada Star Mining Co., Ltd.	Cherry Creek, Nev.
New Puritan Mining Co.	Galena, S. D.
Norman Mines Co.	Northport, Wash.
North Butte Mining Co.	Butte, Mont.
Nenzel Crown Point Mining Co.	Rochester, Humboldt Co., Nev.
National Lead Co.	Office, New York City
Nipissing Mining Co., Ltd.	Cobalt, Ont., Canada
Napoleon Mine	Copperopolis, Calaveras Co., Calif.

Name of Company	Situation of Works
North Star Mine	Silverton, Colo.
North Star Mines Co.	Grass Valley, Calif.
Oro Del Norte Co.	Office, 22 William St., New York
Oat Hill Mine	Middleton, Lake Co., Calif.
Old Eureka Mining Co.	Office, 42 Broadway, New York City
Onetal Mines Co.	Office, Room 2028, 10 Wall St., New York
Ouray Smelting and Refining Co.	Ouray, Colo.
Ozark Smelting and Mining Co.	Magdalena, Socorro Co., N. M.
Oneida Stagg Mining Co.	Idaho Springs, Colo.
Oro Grande Mining Co.	Wickenburg, Maricopa Co., Ariz.
Old Dominion Copper Mining and Smelting Co.	Globe, Gila Co., Ariz.
Park City Mines Co.	Park City, Utah
Pasquale Copper Co.	Bellevue, Ariz.
Pay Roll Mine	Chloride, Ariz.
Penn Mining Co	Campo Seco, Calaveras Co., Calif.
Pioneer Consolidated Co.	Pioneer, Nev.
Polar Star Mines Co.	Black Hawk, Colo.
Pride of the West Mine	Silverton, Colo.
Pacific Mineral Products Co.	Office, 301 North Ave., 19, Los Angeles, Calif.
Pingrey Mines and Ore Reduction Co.	Leadville, Colo.
Pilgrim Mining Co.	Basin, Mont.
Prince Consolidated Mining Co.	Office, McCormick Bldg., Salt Lake City, Utah
Penn-Canadian Mines, Ltd.	Cobalt, Ont., Canada
Pacific Ore Testing Co.	Los Angeles, Calif.
Pike Hill Mines	Corinth, Orange Co., Vt.
Phelps Dodge Corporation	Globe, Gila Co., Ariz.
Portland Gold Mining Co.	Victor, Colo.
Quadmetal Mines Co.	Frisco, Utah
Quatsino Copper Co.	Quatsino, Vancouver Island, B. C., Canada
Ruby Silver Mining and Development Co.	Office, 15 Broad St., New York
Red Monarch Consolidated Mining Co.	Office, 417 Hutton Building, Spokane, Wash.
Rex Consolidated Mining Co.	Office, 120 Broadway, New York
R. R. R. Mining Co.	Patagonia, Ariz
Rupert Mine	Patagonia, Ariz.
Ray Consolidated Copper Co.	Ray, Pinal Co., Ariz.
Ray-Jefferson Mining Co.	Wallace, Idaho
Ray Hercules Copper Mining Co.	Ray, Ariz.
Reindeer Queen Mining Co.	Mullan, Idaho
Rico Argentine Mining and Milling Co.	Rico, Dolores Co., Colo.
Royal Basin Mining Co.	Maxville, Granite Co., Mont.
Royal Gold Mines Co.	Hodson, Calaveras Co., Calif.
Rochester Combined Mines Co.	Rochester, Nev.
Reward Gold Mines Co.	Manzanar, Inyo Co., Calif.
Silver Plume Reduction Co.	Silver Plume, Colo.
Silver Bell Mine	Ophir, Colo.
Snowstorm Mines Consolidated	Kellogg, Idaho
Smuggler Union Mining Co.	Telluride, Colo.
Stewart Mining Co.	Kellogg, Idaho
Socorro Mining Co.	Mogollon, N. M.
Spanish Belt Silver Mines	Tonopah, Nev.
St. Louis Smelting and Refining Co.	Office, 111 Broadway, New York
St. Johns Mines, Ltd.	Montezuma, Colo.
Superstition Consolidated Mining Co.	Phœnix, Ariz.
Standard Gold-Copper Mining and Milling Co.	Salida, Colo.
Salisbury Copper Co.	Gold Hill, Rowan Co., N. C.
Santa Fe Gold and Copper Mining Co.	San Pedro, N. M.
Schuykill Mining Co.	Office, 345 Rialto Bldg., San Francisco, Calif.
Shannon Copper Co.	Metcalf, Greenlee Co., Ariz.
Shattuck Arizona Copper Co.	Bisbee, Ariz.
Sheldon Mining Co.	Walker, Ariz.
Silver Lake Custom Mill	Silverton, Colo.
Silver Cable Mining Co.	Mullan, Idaho
Silverado Mining Co.	Office, Old National Bank Bldg., Spokane, Wash.
Silver King Consolidated Mining Co. of Utah	Park City, Utah
Silver King Coalition Mines Co.	Park City, Utah
Standard Mine	Idaho Springs, Colo.
Success Mining Co., Ltd.	Wallace, Idaho
Sunnyside Mines	Eureka, San Juan Co., Colo.
Simonds & Lathan	Melones, Calaveras Co., Calif.
Sable River Copper Mines Co.	Massev. Ont., Canada
Silver Hoard Mining Co., Ltd.	Ainsworth, B.C., Canada
Slocan Star Mines, Ltd.	Silverton, B. C., Canada
Silverton Mines, Ltd.	Silverton, B. C., Canada
Standard Silver Lead Mining Co.	Silverton, B. C., Canada
St. Joseph Lead Co.	Bonne Terre, Mo.
Surprise Mine	Sandon, B. C., Canada
Telluride Chief Mining Co.	Kingman, Ariz.
Tennessee Copper Co.	Copper Hill, Polk Co., Tenn.
Tarbox Mining Co.	Saltese, Mont.
Terrible Dunderberg Mining and Power Co.	Silver Plume, Colo.
Texas Graphite Co.	Burnet, Tex.
Tintic Milling Co.	Silver City, Utah
Tonopah Extension Mining Co.	Tonopah, Nev.
Tomboy Gold Mines Co., Ltd.	Telluride, Colo.
Trethewey Silver Cobalt Mine, Ltd.	Cobalt, Ont., Canada
Utah Copper Co.	Garfield, Utah
Utah Metal and Tunnel Co.	Bingham, Utah
Utah Apex Mining Co.	Bingham Canyon, Utah
United States Exploration Co.	Office, 618 Pacific Bldg., San Francisco, Calif.
Union Copper Mine	Milton, Calif.
Underwriters' Land Co.	Joplin, Mo.
United Copper Mining Co.	Chewelah, Stevens Co., Wash.
Union Basin Mining Co.	Golconda, Ariz.
United States Smelting, Refining and Mining Co.	Needles, Calif.
Utah Consolidated Mining Co.	Bingham Canyon, Utah
Utah Leasing Co.	Newhouse, Utah
Vipont Mining Co.	649 E. S. Temple St., Salt Lake City, Utah
Victor Power and Mining Co.	Knob, Calif.
Vindicator Consolidated Gold Mining Co.	Independence, Colo.
Wanakah Mining Co.	Ouray, Colo.
Wellington Mines Co.	Breckenridge, Colo.
Westinghouse Estate	Duquesne, Ariz.
Wilson Mine	Robinson, Colo.
Winnemucca Mountain Mining Co.	Winnemucca, Nev.
Walker Mining Co.	Portola, Plumas Co., Calif.
Weringer Mines Co.	Woody, Calif.
Wedge Consolidated Mines Co.	Ouray, Colo.
White Pine Exploration Co.	Cherry Creek, Nev.
Weedon Mining Co., Ltd.	Sherbrooke, Que., Canada
Young American Mine	Sierra City, Calif.
Yavapai Consolidated Gold-Silver Copper Co.	Crown King, Yavapai Co., Ariz.
Yellow Pine Mines	Crisman, Colo.
Y. P. Mining Co.	Maxton, Ariz.
Yerrington Malachite Copper Co.	Mason, Lyon Co., Ariz.
Yuma-Warrior Mining Co.	Harqua Hala, Ariz.
Toniber Butte Milling Co.	Butte, Mont.
Burro Mountain Copper Co.	Tyrone, N. M.
Old Dominion Copper Mining and Smelting Co.	Globe, Gila Co., Ariz.
Rambler-Cariboo Mines	Silverton, B. C., Canada
Lucky Jim Mine	New Denver, B. C., Canada
Galena Farm Mine	Slocan City, B. C., Canada

Arizona Molybdenite Mining Co.	Yucca, Ariz.
Carribeau Mining Co.	Ophir, Colo.
Champion Consolidated Mining Co.	Champion, Ore.
Darwin Lead and Silver Mines and Development Corpn.	Darwin, Inyo Co., Calif.
Fierro Copper Co.	Fierro, N. M.
Golden Fleece Mill	Lake City, Colo.
Highland Mary Mines Co.	Ophir, Colo.
Ima Consolidated Mining and Milling Co.	Ima, Idaho
Kenyon Copper Mines, Ltd.	Massey, Ont.
Mountain Top Mining Co.	Ouray, Colo.
Mines Operating Co.	Butte, Mont.
Progress Mining and Milling Co.	Leadville, Colo.
Senorito Copper Corpn.	Senorito, N. M.

SUPPLEMENTARY LIST OF COMPANIES WHOSE WORKS OR OFFICE ADDRESS IS NOT OF RECORD

Adams Mill	Miller Independence Co.
Bonnie Clare Mines Co.	Molybdenum Mining and Reduction Co.
Bonanza King Mining Co.	Middlepass Mines Co.
Belcher-Hughes Mining and Milling Co.	Mike Horse Mining Co.
Boulder Creek Mining Co.	Memphis Red River Mining Co.
Central Mine	Promoter Mine
Consolidated Mines Development Co.	Rose Chemical Co.
Dixie Meadows Mine	Santa Xavier Mining Co.
Dewey Mine	Sunshine Copper Co.
Downey Bros.	Sandewal Consolidated Copper Mines
Encomotas Copper Co.	Silver Camp Mill
Fairview & Red Rock Mines Co.	South Star Mines and Smelters
Florida Silver Mines	Southern Cross Mine
Foerster Mill	Texas Hill
Gold Ore Mine	Tiger Mine
Gold Chariot Mine	Western Ore Concentration Co.
Great Falls Barker Mining Co.	Wallace Smelter Plant
Hawke Milling Co.	Waldorf Mine
King Copper Mine	Western Gold and Copper Co.
Logan Mining and Milling Co.	

Tungsten and Molybdenite in North Queensland, Australia

The increasing demands for bismuth, tungsten and molybdenite ores, which metals are often associated in North Queensland, and the excellent prices now obtained are causing more attention to be directed to the districts producing these metals. As far as the British Empire is concerned, the Imperial Government has fixed prices for tungsten and molybdenite ores, but high prices are expected to rule for a considerable period.

The more important holdings of the Wolfram, North Queensland, district have been acquired by the Thermos Electric Ore Reduction Corporation of Luton, England. A start has been made toward active mining operations on a large scale; a central power station of 800 hp. is being erected. Diesel engines coupled to electric generators will supply power to the compressor plants at the mines and for a mill that will be erected.

The field has been languishing for some years owing to want of sufficient capital to develop the mines and also to lack of cheap and efficient crushing facilities. The mines have been worked by following the pipes or crevasses of quartz between the porphyry or granite walls. These pipes are sometimes phenomenally rich in patches, alternating with lean spots of varying size. Wherever the pipe enlarges, the metal contents generally prove poorer; that is, the metals are more sparsely distributed and cannot be easily picked by hand for bagging. Mining is rendered difficult, owing to the irregular directions taken by the pipes in increased depth.

In 1916 and 1917 there were a few mines, privately owned and worked, producing as much as a ton of molybdenite and as much or more bismuth-wolfram weekly. The quality of the metal won is excellent, the molybdenite assaying 87% to 94% for MoS_2 and the tungsten often assaying 66% to 68% tungstic acid. All this metal was picked by hand as the ore was brought to the surface. After hand-picking, the remaining ore is sent to the mill for treatment.

It is therefore with a great deal of interest that the coming of a new concern is watched, and it is hoped by the independent miners and engineers on the field that the problem of efficiently treating the product of the field will be solved by the new company. It is probable that the new company will be free from the prejudices and defective practices fatal to quick extraction.

Although the annual production of this field canot be far short of $500,000 for the three metals, the present mill, with a capacity of one ton per hour or less, has had to satisfy the mining public, which, whenever possible, resorted to hand-picking, the mill being unable to treat the richer ores at all, and with difficulty ores containing 6 to 10% of the mixed metals. The milling consists in crushing with stamps, extracting the wolfram and bismuth by jig and table concentration and the molybdenite by flotation, kerosene being used as a reagent.

The molybdenite is badly broken up by the action of the stamps, and the loss in the jigs and tables is excessive. In spite of protests from the producers who have to pay for this most inefficient milling and heavy losses in tailings, the late owners of the plant would not attempt to improve their methods.

A charge of $9 per ton for milling the low-grade ores and $9 per milling hour, or approximately $18 per ton on high-grade ores, was collected for this work.

Operations of the French Company

In 1913 a French company started operations, intending to treat the dumps and ores too poor to stand transport or treatment by the existing mill. There was about 60,000 tons of dump material available, all of which had been picked over by hand. A sudden rise in prices before the French company got into operating condition caused a general treatment of the dumps once more by hand, and when the company started work the dumps were about cleaned up. Unfortunately, they had to cease operations since they had no mining interests in the field and their capital was exhausted. Their crushing plant remains on the field, and its large size alone precludes operations on a small scale. Lack of capital has hitherto prevented any reconstruction.

The method of crushing favored by the French company was to take the run-of-mine ores, obviating hand-picking entirely. The ore was passed through rock breakers to rolls in series with screens. Eight-mesh screen was finally used for retaining the molybdenite flakes. This method recovered most of the molybdenite and left very little for flotation. The nature of molybdenite calls for some such treatment to avoid sliming; wolfram, being also a sliming metal, was likewise benefited by not passing under stamps. The system was cheap and efficient, and much useless pounding of the ore was obviated.

It is hoped that the advisers of the new company will make an impartial inquiry into the merits of the crushing systems previous to making their choice. Engineers on the field at least are not uncertain of the result.

Sampling and Analyzing Zinc Ores and Products

By J. H. HASTINGS*

Practical suggestions for sampling ores in place, old dumps, mill and smelter feed, concentrates and spelter. Methods in vogue at mines, mills and smelters. Care and disposal of samples at customs smelter and custom mills.

To describe the sampling of mines for purchase would require a volume by itself, but a general description of the common practice may be an aid in sampling. Zinc properties are sampled, in general, in two ways, according to the nature of the deposit and the amount of development; by making cuts across the face of the vein or deposit, or by drilling with a churn or diamond drill. The former method is commonly used in veins, the other in sampling sheet deposits such as those of the Joplin district.

An engineer may be called upon to make an examination of a zinc property, which may be anything from a prospect without development to a fully developed mine with ore reserves already blocked out. If it is of the vein class, his aim will be to get his samples from across the vein at certain distances along the strike and dip. This is not such a difficult matter provided the vein is sufficiently opened up, but when the deposit is simply an irregular mass, it is a difficult matter and his chief aim will be to sample the deposit at regular intervals.

In the case of a prospective property that has not been opened below the surface, all that can be accomplished in the way of sampling is to dig trenches across the deposit at certain distances from each other. These trenches will not necessarily be at right angles to the dip or strike of the orebody, but will show what there is near the surface. It is only a hazard as to what to expect farther down.

General Uudergrouud Sampling

Some mines are sampled every five or ten feet along the vein by taking samples from the floor or the roof of the drifts and at like distances in the shafts, winzes or raises when in the vein. These samples are generally from a 3- or 4-in. wide channel cut in the ore with a single-jack and gad. They weigh from 5 to 40 lb. each and are placed in canvas sacks and tagged. As a rule the engineer marks the samples simply by number and records the sample number on a blueprint of the mine plan, which makes reference easy and convenient, the samples representing the grade of the ore in place in the mine.

The samples must be reduced to a convenient size and mesh for analysis and also dried. The best manner in which to reduce the sample is to first grind it in a small jaw-crusher to about ¼-in. diameter; then dry, mix and reduce the quantity by quartering to 10 lb. This can be further reduced to 30-mesh in a "coffee mill" and riffled to ¼ lb. and then pulverized in a disk pulverizer or on a bucking board until all the pulp will pass through a 100-mesh screen. The final sample of 4 oz. is placed in an envelope or paper bag and properly marked and is ready for analysis.

The type of mineral deposit occurring in the Joplin district may be sampled by drilling with a churn drill. Holes are spaced at regular intervals and the drillings removed from the hole with a sand pump. After the drill gets down into the ore, these drillings may be emptied into a tub and allowed to settle, the water drained off, the sample washed into a pan, dried, mixed, any lumps reduced and ground to 30-mesh, riffled to a quarter pound and pulverized to pass through a 100-mesh screen, when the sample is ready for analysis.

Similar deposits may be drilled with the diamond drill and the part of the core containing mineral matter reduced. Of course, in any kind of sampling sufficient data as to distances, locations, etc., must be kept so as to insure a complete record, from which measurements the engineer bases his calculations of the tonnage in place, and from the analysis of the samples the value of the ore.

Other Mine Samples

There are many old dumps throughout the country containing zinc, and it is another problem for the engineer to obtain a representative sample from them upon which to base the calculation of their value. The two accepted methods are the pipe and the opencut methods. The former can be used only when the ore has been broken finer than a 3-in. cube, when it is feasible to drive a 3-in. pipe into the dump and withdraw it filled with ore. The other method, the use of the trench, consists in digging through at regular distances and stripping down the walls of the trenches for the samples, which may then be crushed, quartered, ground, mixed, riffled and pulverized for analysis. In case the pile of ore is very high and in form of a cone, the trenches can be dug from the periphery and down from the top.

After the mine or prospect has reached a productive stage, samples must be taken from day to day as the work progresses in order to keep informed of the grade of the material being extracted to distinguish between ore and waste rock. These samples also provide a means of keeping a check on the original estimates of the value of the ore deposit. The common method of taking samples from a mine is simply to have the foreman take a grab sample of the pile of material shot down and by taking cuts from the different faces where the work is in progress. These samples are dried, crushed, ground and pulverized and, as there are generally a good many of them, are small in size, to make less work.

The shipments from the mine are either direct smelting or milling ore. In many instances the mill is situated near-by; in others, the shipments are made over a considerable distance. In case of smelting ore the shipments are sometimes made to some custom smelter, sometimes hundreds of miles from the mine. When the ore goes to a custom plant, the receiving

*Monongahela, Penn.

works' samples are used as a basis for settlement. A check sample, which should be as nearly representative of each carload as facilities at hand can make it, should, in all cases, be taken at the mine. In the case of direct smelting ore, each carload is generally sent to a public sampling works, where an automatically cut sample is taken and the car rebilled to its destination. This is a satisfactory procedure where convenient, but even in this case a check sample is taken at the mine.

When the mill is adjacent to the mine, the removal of a sample automatically can be accomplished with a mechanical sampler run in connection with the crushing plane. When sent to a custom mill, a certain amount, preferably one-tenth of the weight, should be thrown aside while loading a car, and this crushed or broken with a hammer to 2-in. lumps, when it can be tenth shoveled and this tenth broken to ½-in. and reduced by quartering to 50 lb. and a 5-lb. moisture sample removed from the discarded portion. The 50 lb. is then dried, ground in a "coffee mill" to 30-mesh, riffled to ¼ lb. and this sample pulverized. This procedure applies to shipments to smelteries as well. In the latter case the ore is nearly always calamine and easily broken. These samples should check quite well with the results obtained from the receiving-works' samples.

Once the ore is received at the mill, it must be sampled automatically as it is unloaded or by the tenth shovel process already described, and the moisture determined. The next problem is to secure representative samples by which to control the grade of the products and follow the losses. The daily mill feed must be sampled if feed is from stockpiles, and such samples should show results consistent with the ore receipts. The next samples in importance from an economical viewpoint are the tailings in order to determine the losses occurring in the milling process. A practical way to obtain the mill feed or crude-ore samples is to have an automatic sampler cutting out a certain portion, or have a workman periodically reserve a portion of the crushed ore. Some sort of automatic tailing sampler should be installed, if possible, or this sample can also be taken periodically. As to sampling the intermediate and finished products, automatic devices should be used wherever practicable in order to eliminate the human factor, but, of course, this is not always feasible especially in a small mill.

Mill Shipment Samples

The sampling of the products of the mill for shipment, ranging in size from ½-in. down to the finest pulp —that is, from jig concentrates to flotation concentrates —and from dry material up to that holding 18 to 20% moisture, should be carried out in such a manner as to be a reliable check on the sampling done at the smelting works. The usual methods for sampling the fine material are by the pipe sampler, either from the car or wheelbarrow used in loading, and by digging a certain number of holes in the ore after being loaded in the car and scraping the samples up from the walls of the holes. Of the two methods, that of the holes appears to be the most accurate, as ore is likely to stick in the pipe and not give an even section of the carload. After the sample is taken from the car, if finer than 30-mesh, it is quartered to about 5 lb.; if coarser, about 50 lb. is taken and reduced in mesh by grinding, then in quantity by quartering. A moisture sample consisting of the regular sample for analysis or an extra portion should be weighed out and dried. This sample usually amounts to 5 lb., and is weighed on special moisture scales, supplied with double beam to read percentage direct. The sample is further prepared for analysis by methods already described.

The next stage in the sampling process is when the ore arrives at the smeltery. It may come in the form of lump calamine, lump sulphide or any of the various mill products, both calamine and sulphide. (The term calamine is used here to designate any of the oxidized zinc ores.) The ore may be imported from Australia, Sardinia, China, and various other parts of the globe, or shipped from different local points. It is customary for the shippers to have a representative on the ground to inspect, in their interests, the smelter's sampling methods, and, in case of imported ore, for the Government also to have a man stationed at the works to take the necessary samples to enable a proper duty to be exacted.

At a few of the zinc smelteries there are proper facilities for sampling lump ore automatically or at least mechanically, but at most it is rather a slow and unsatisfactory process to procure a representative sample. Where neither facility is provided, the lump ore must be sampled by taking one-tenth, or one-twentieth of a car and breaking the lumps to 2-in. size either by crusher or hammer; taking one-tenth of this portion and again breaking the lumps to ½ in.; then mixing and quartering the ore to 50 lb., taking out a 5-lb. moisture sample and grinding, riffling and pulverizing. When the government requires samples, the final sample for pulverizing should weigh about 1½ lb; the sample is divided into six portions—two for the Government, one for the shipper, one for the smelter, one for umpire purposes and one to be held in reserve. The final samples should be properly marked and sealed. The finer ore can be sampled in the cars or as it is being unloaded as in mill shipments.

Lot Samples at Smelter

After the ore is unloaded and sampled and in the storage bins, its course through the smelting process begins. The ores may be smelted separately or mixed in different proportions beforehand. A daily sample is required of each kind of crude ore charged to the roasting kilns, or to the spelter furnaces, according to whether it is sulphide or oxide. The samples are generally taken from each car of ore as it is hauled to the kilns. A pipe sampler, slotted and pointed and closed at the bottom end, can be thrust into the ore and gives a very satisfactory sample as the ore is dry and fine. This gives a bucketful of ore which may be riffled to 5 lb., dried for percentage of moisture, ground to 30-mesh, divided by a Jones' riffle to from 2 to 4 oz., and pulverized. The roasted ore is sampled in a manner similar to the crude ore. A sample should be taken for each set of roasting hearths.

The roasted ore, after being conveyed to the mixer building, is deposited in bins or mixed at once in furnace charges. The furnace charges are sampled as they are being made up, preferably with a pipe sampler, or taken from the stream of ore being discharged

from the bins—the samples being placed in cans. If it is wet calamine ore, the cans should have screw tops. There should be a sample of the charge for each furnace. The samples are prepared the same as the kiln samples. Moisture samples should be taken in all cases on the crude ore, since otherwise errors are likely to be introduced through handling or manipulation.

The residues that are raked out of the retorts, if they are thrown away, should be sampled periodically, either by taking shovelfuls out of the residue car or by the pipe method. If they contain other metals and are reserved for re-treatment, of course each car shipment must be carefully sampled by the pipe method or by the tenth or twentieth shovel. It is sometimes difficult to procure an average daily sample, especially if the residues are allowed to accumulate for more than one day in bins beneath the spelter furnaces.

The spelter must be sampled periodically by reserving a certain number of slabs from each draw, and if a special grade is being made, each car must be thoroughly sampled. The standard method set by the American Society for Testing Materials is to take six slabs at random and saw each slab completely across from the middle of one long side to the middle of the other and use the sawdust as the sample, or drill three 9-mm. holes along one diagonal of each slab, boring completely through and taking care to make fine drillings. The holes should be drilled as nearly as possible at the middle and halfway between either end and the middle of such diagonals. Go over the drillings or sawings with a powerful magnet to take out any iron that may have come from the drill, or saw and mix the sample thoroughly. The drill or saw must be thoroughly cleaned before use, and no lubricant shall be used in either drilling or sawing.

Analysis of the Samples

The analyses necessary on the samples from a zinc-mine examination depend upon the character of the ore. Determinations of the metals occurring in commercial quantities must be made, also determinations should be made on enough samples to show the impurities present affecting the metallurgical treatment of the ore.

The samples representing shipments to smelteries should be run for zinc and such other metals as are paid for and for any impurities for which the smelter is penalizing. The samples of shipments to custom mills must be run for zinc and other metals and impurities, as stated for smeltery shipments. In cases where the mill belongs to the mining company, the samples should be run for zinc and other valuable metals, leaving the determination of impurities to be made on the mill-receipt samples.

At a custom mill the buyers' pulp is anaylzed in duplicate for zinc and other metals being paid for, and also for impurities on which a penalty is imposed. A pulp sample is sent to the shipper, who analyzes it for the same, and on comparison of the shipper's and buyer's results, if there is more difference than the limit which has been agreed upon beforehand, the umpire pulp is sent out to a third chemist, and if his results fall between the two, it is taken as final; if not, the one nearest to the umpire's result, whether purchasers or sellers, is taken for settlement.

The analysis required of the finished mill products consists in determining the metals that the smelter would pay for as flux or as recoverable and the impurities affecting the value or grade which could be removed in the milling process.

The furnace charges are run for zinc and the residues from the spelter furnaces for zinc and other valuable metals and, in case of shipments, for impurities that may affect the further smelting of them.

Spelter consists of four grades—High-Grade, Intermediate, Brass Special and Prime Western—and according to the American Society for Testing Materials should show analyses as follows:

	Zinc, Minimum	Cadmium, Maximum	Iron, Maximum	Lead, Maximum	Aluminum	Other Elements, Tin, Arsenic, Antimony, Sulphur	Sum of Cadmium, Iron and Lead, Maximum
High-grade.....	99.85	0.05	0.03	0.07	None	None	0.10
Intermediate....	99.35	0.50	0.03	0.20	None	Traces only	0.50
Brass special....	99.60	0.75	0.04	0.75	Traces only	Traces only	1.20
Prime western..	98.00	0.75	0.08	1.50	Traces only	Traces only	2.00

Analysis of the periodical samples should be made in accordance with the foregoing, likewise, the individual shipments of the first three grades.

Iron Industry in Chile

Among the subjects considered by the National Congress of Chile during the special session convened May 9 was the adoption of measures for the establishment of the iron industry.

The iron and steel imports of Chile during 1913 amounted to 266,000 metric tons, which would indicate an actual consumption of 65 kg. per capita. This consumption is considerably less than that recorded in countries where the development of manufactures is further advanced than in Chile. The per capita consumption in Germany, for instance, was 380 kg. prior to the war; that of the United States, 250; of Great Britain, 170; and of France, 150. There has begun an era of industrial progress in Chile, and it is probable that the per capita consumption of iron and steel will increase.

While it is true that Chile possesses iron mines of considerable richness, the absence of good coking coal will be a handicap to the new industry. It is at present planned to use charcoal in the furnaces, and the government is planning to secure the services of Swedish and Belgian experts who are familiar with this industry. The forests of southern Chile will supply an abundance of charcoal for many years to come, and the rivers of the same region can be made to produce the horsepower required for the new industry.

Indian Mica Production Increases

Mica produced by mines in southern India in the year ended June 30, 1916, was 505,037 lb. compared with 331,568 lb. in 1914-15, says *Commerce Reports*. Exports from Madras in the fiscal year ended Mar. 31, 1916, were 576,240 lb. (all to the United Kingdom); in 1914-15 they were 621,376 lb. (133,316 lb. to Germany and 4592 lb. to the United States); and in 1913-14 the total was 1,217,552 lb. of which 688,576 lb. went to the United Kingdom, 481,600 lb. to Germany, 34,944 lb. to Holland, 11,872 lb. to the United States, and 560 lb. to others.

Organization of Industry in Great Britain*

It is not easy to translate into terms of American finance, industry, dimension and employment the thing that is happening in Great Britain in the development of the munitions industry. The thing is so big as to be almost beyond understanding. Today the British Ministry of Munitions is the greatest employer of labor in the world. It controls in the name of the government more than 20,000 workshops and factories and employs almost 2,000,000 people. It is by a long way the greatest single employer of labor in the world. More than this, the activities of the Ministry are constantly expanding. Under the defense of the realm act and the munitions act the government has taken to itself perfectly unprecedented power over industry. . . .

England's Enlarged Industrial Equipment

Great Britain will emerge from the war with her industrial equipment immensely varied and enlarged. A great part of the work done by the industrial and scientific agents of the war services will be of the greatest permanent usefulness. For instance, attention has recently been called to what English scientists and artisans have done in the matter of producing high-power lenses. Formerly the Germans monopolized this business. Nobody in England knew much about the manufacture of this kind of glass or its conversion into lenses. War made it absolutely necessary that these aids to vision be produced in numbers never before dreamed of. A committee from the Ministry of Munitions set about to discover the formulas for producing high-power glass and succeeded. Today it is confidently declared that England can surpass the Germans in this, one of the fields in which the Germans regarded themselves as supreme.

Before the war England, although itself a great iron-ore producer, brought immense quantities of ores from Spain, Scandinavia and other countries. The shortage of shipping and the increased requirement of iron and steel made it absolutely necessary that more of the ore be produced at home. The Ministry of Munitions declared in a recent address that accomplishments in this direction are equivalent to increasing the national product of steel by more than 2,000,000 tons a year. Committees have been formed to project this enlarged scale of the metal industry beyond the day of peace and to insure expansion of production after the war.

There will of course be demand for everything that can possibly be produced in this line, because all kinds of iron and steel construction that could possibly be postponed have been prohibited during the war. London and every other city in England is dotted with half-finished buildings on the American steel-frame plan which were started before the war and left unfinished when the edict went forth that no more steel could be spared for such purposes. It has been almost impossible to build any kind of structure in these islands in the last two years. No matter how necessary it seems, a hard-hearted building authority which is in intimate league with the military and munitions department insists on viséing every proposal for construction work, and it is about as easy for a camel to go through the eye of a needle or for a rich man to escape the income tax as it is for a mere citizen to get the necessary permit to erect a building of any kind.

Forced Economy in Materials

A very important part of the government's work of supervising industry has been the enforcement of measures for economy in materials, labor, transportation and the like. When the flour mills of the country, for example, were taken over by the government, there was an inquiry which developed that the transportation of grain to small mills was costing more money than the actual milling process. The result has been a movement to close small establishments and to concentrate the business in large ones for the sake of economy in both transportation and operating costs. The same thing has been applied to many other industries. Before the war England looked up to and admired the American system of large-plant production but imagined it could never be adapted to the requirements of a country like England. Today, England is advancing so fast in this direction that by the time peace is restored it will be quite able to compete with America and Germany in this regard.

All manner of materials which formerly were allowed to go to waste are now gathered up and conserved with the greatest care under government direction. For instance, just the other day an announcement was made that hereafter worn-out army boots would be gathered in depots and sold either to people who wanted the material in them or for further wear. The army boot is made of the best possible material, and after it has been utterly worn out for the purposes of the soldier a large share of the material in it is available for other uses.

England has discovered how to produce all the potash it immediately requires; America is likewise increasing its domestic potash supplies, and the Kali Syndicate is likely, if the war lasts long enough, to discover that its monopoly of many years is a punctured balloon.

All kinds of scrap metal are gathered up with the greatest care. Shortage of shipping made it absolutely necessary to draw more exclusively than ever before on the timber supplies of the islands, and today one of the most disheartening sights one will note from a railroad train is the spectacle of gangs of Canadian lumbermen cutting down and logging the beautiful forests. It is worth while to add that this work likewise has been done as carefully and systematically as wartime conditions permit, with a view to inflicting the least possible injury on the forests. Trees are carefully culled out of them in such a manner as to leave the smaller ones and give them a better chance to develop. There is no such wicked waste of timber supplies as has been going on in the great forest areas in the United States for decades past, with the result of finally bringing that country to within the verge of a lumber famine.

These are just a few examples of the industrial reorganization, the new economies, the increasing efficiency, the intensive devotion of national resources to the national cause, that has been effected in Great Britain. The point is that as the United States more and more realizes what its opportunity in this war is, it will appreciate every increasing necessity of adopting every measure of conservation and efficiency that has been adopted in Europe and improving upon them.

*From an article in the New York "Sun," by Judson C. Welliver, its London representative.

Tin Smelting in Bolivia

By Mark R. Lamb
Metallurgical engineer, 30 Church St., New York.

Potosi may be said to be the birthplace of tin smelting in Bolivia. Many years ago—before you and I knew anything about tin—Don Luis Soux was in charge of the silver mines of a group of very aristocratic people. These silver-mine owners were practically "titled," since to be an *Azoguero* was like being a member of the Engineers' Club in New York. But the profits from the silver mines began to diminish, and Don Luis suggested that he could make a profit by producing tin. You see, the ore was treated only for silver and the tailings contained much tin, which was run to the river.

His master stormed at the suggestion that they should descend to making tin, and he was given peremptory orders not to blot their escutcheon with tin. However, Don Luis needed the money and went ahead and made tin and sold it and turned in the profits, merely asking that a part of these excess profits be at his disposal to increase his tin plant.

You can easily imagine their unbounded indignation at his presumption. Their letter, written in curious Spanish of the period, put Don Luis firmly in his place for presuming to dictate how the *Azogueros* should invest their own money. Afterward, Don Luis, who saw the opportunity and importance of the tin, began to accumulate properties. His efforts and failures and final triumphs make an absorbingly interesting story, and you shall have it later.

First Smelting of Tin

One of his first successes was the smelting of tin ores in water-jacketed furnaces. He had three, and the fued was charcoal. At present no smelting is done, but the margin between smelting and shipping is very narrow. In fact, where concentrates below shipping grade cannot be raised in tin content, probably smelting would be more profitable, especially with present high freight, expensive concentrate bags and shipping delays.

The three water-jacketed furnaces are connected by flues to boilers. In operation the furnace is nothing but an efficient gas producer which incidentally smelts tin. The gases are used to raise steam in the boiler, for remelting the tin in the refining plant and for any other required power purposes. As the tin comes from the furnace it is about 92% pure and is brought up to 96-97% by remelting.

Another tin smelter in Potosi, Don uan Maurice, makes an excellent white metal, as all the necessary metallic ingredients are produced in the district. The sale of this bearing metal is growing. The price of exactly the same metal from abroad is more than double. It is the same condition that ruled in the rubber market a few years ago, when American rubber buyers preferred to pay freight and commission and buy in London rather than buy in New York directly from the Bolivian producers.

But to get back to tin. A subsidiary of the Llallagua company is building a small reverberatory tin smeltery at Arica and is pushing the work rapidly to completion. Besides making high-grade pig tin, it will make the usual byproducts, such as solder, bearing metal and bronze. Mr. Copeland is sticking strictly to recognized practice in the art, and his several years devoted to the study of the industry everywhere that tin is smelted, makes it a certainty that the smelting will be a success. The difficulty of shipping concentrates to Europe at present adds to the certainty of success of this smeltery.

There is another furnace that is making tin from Bolivian concentrate. It is extremely simple and attractive in appearance and, like the Bolivian *yungas*, is pregnant with possibilities. It looks to an outsider, however, like trying to get the fabled genie back into the bottle. The furnace is oval, 3 and 4 ft. in diameter and 3 ft. deep, and uses 300 hp. in ordinary operation. To confine all these horses in such a small stable for any length of time results in melted brick, destroyed cover and much tin fume.

Considerable fuel is required in the reduction of the tin. The explanation of the absence of iron, tungsten, antimony, lead, zinc, bismuth, arsenic, silica, gold, silver, etc., at the temperature of the electric furnace and in a reducing atmosphere, is that the slag is 64% silica.

Quality of Tin Produced

At the time of my visit there was a very attractive pile of pigs of tin ready for shipment. These were said to assay 99.64%, and a sample I took assayed 0.17% As, 0.28% Sb, 0.74% Cu, 0.05% Fe, 0.12% Pb, and 98.64% Sn (by difference), which is somewhat different from 99.64%. Of course, the sample I took was not of all the bars, as I had to take it when no one was looking. Also, it was not a sample of what had been shipped before nor of what will be shipped in the future. It is good work, compared with blast-furnace practice, but is not equal to ordinary reverberatory results.

The smelting of tin in Bolivia came near being made a monopoly or worse. The "worse" was that the tin miner was to be obliged to sell his concentrates to the smelters.

The market for tin concentrates is so disturbed that there will be many changes, and smelting in Bolivia will have a much better opportunity to become established than when German, English and Belgian smelters competed for the concentrate.

A shipment of 11 tons of pig tin smelted in the electric furnace at La Paz has recently been sold in New York. The price obtained was 50¾c. per lb. when best Banca sold at 55c. and Straits sold at 60c. to 61c. per lb. The analysis of the lot is given in the table.

ANALYSIS OF TIN SHIPMENT

	%
Lead	0.076
Arsenic	0.467
Antimony	0.009
Iron	0.225
Copper	0.147
Sulphur	0.077
Tin (by difference)	98.99

Tin is not sold on the basis of analysis. Nothing but Straits tin is considered delivery on the New York metal market, so that such lots of tin from Bolivia, China and other points must be sold simply by seeking a purchaser and making a bargain.

The tin-plate manufacturers insist that nothing will serve their purpose except the Straits tin, which assays better than 99.75%, and they insist that they will be the first to appreciate and adopt a method of using the cheaper tins in the manufacture of their products.

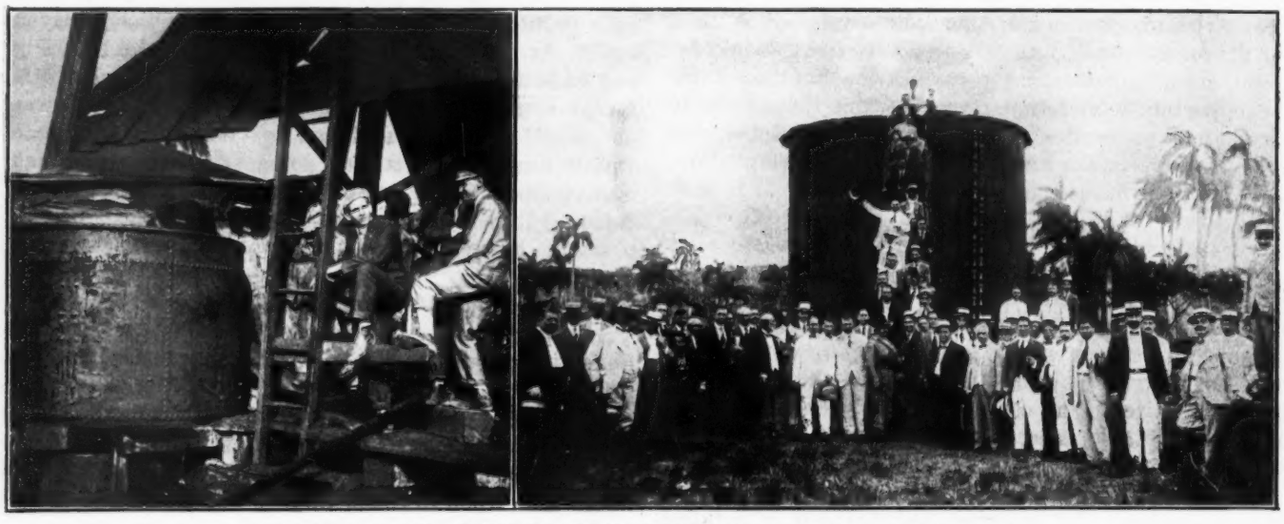
Whether this is really true—that is, whether these manufacturers really try to use tin from other places or not—is difficult to ascertain. There may be some thoroughly good reason for this preference.

The fact remains, however, that before the war the difference between Banca and Straits was not much over 1c. per lb.; the difference today is 8c. per lb., and the metal buyers will tell you that this is due to the fact that before the war Europe absorbed all this off-color tin, whereas now it is all offered in this market and there is keen competition in the disposal of it, so that heavier price concessions must be made. This will, in part, explain to the producer of pig tin in Bolivia why his tin, which assays 99%, is not within 1% as valuable as the product coming from the Straits and assaying up to 99.75% metallic tin.

First Producing Oil Well in Cuba

HAVANA CORRESPONDENCE

Well No. 5 of the Union Oil Co., which has lately come into production, was drilled on the Santiago claim, leased by the company. The Union Oil Co., which has its headquarters at Empedrado 34, Havana, is a Cuban corporation. Its oil properties are at Bacuranas in the Province of Havana, only 13 miles from the capital.



VIEWS OF THE UNION OIL CO.'S OPERATION AT BACURANAS, CUBA

Well No. 5 is the first well in Cuba to produce oil in commercial quantities. It is 1005 ft. deep and was making about 10 bbl. a day. On June 5 it was dynamited and began to yield about 150 bbl. in 24 hours. The oil flows by periods three times a day, making about 50 bbl. at each flow. Oil was struck at 925 ft. in a layer of oil sand 80 ft. in thickness. It is the first well where any considerable thickness of oil sand has been found. Since the photograph was taken, the flow of oil has become more steady and there is reason to believe that the production will increase. Another well (No. 4) on the same property, distant about 200 ft. from No. 5, is also producing, by pumping, nearly 25 bbl. in 24 hours. It is only 550 ft. deep, and its production at that depth is somewhat unusual.

The geology of the field has not yet been thoroughly investigated, and the character of the formation is undetermined, but it may be stated that the oil is found near the contact of a serpentine belt, which stretches from east to west in the northern part of Havana Province, with sand and limestone strata probably of Cretaceous age. Oil seepages may be noted at different points along the line of contact; also numerous asphalt (maltha) deposits.

The Union Oil Co. has been drilling on this field for the last two years, and although oil was struck a year and a half ago, it was only during the month of June this year that quantities of oil of commercial importance.

The Santiago claim on which wells Nos. 4 and 5 are situated is 12 hectaras in extent and distant about 13 miles from Havana. This distance can be traveled nearly 12 miles over macadam roads and about one mile over earth roads. This claim and the Francis, the Juan Francisco and the Inglaterra claims, which belong to the Union Oil Co., are all in the Bacuranao district, municipality of Guanabacoa, Province of Havana. On the Juan Francisco claim, adjoining the Santiago, a well is being drilled, which is about 1790 ft. deep at present. At 500 ft. and at 600 ft., small amounts of oil were struck, and at 660 ft. some gas came out. At 900 ft. more gas was noted. No sandstone has been reached as yet, but the work will be continued until conclusive evidence is secured. The opening of this well in Cuba is of considerable importance, since it proves the existence of the oil in such quantities as may be commercially profitable.

Chromic Iron in New Caledonia

A citizen of Sydney, says *Commerce Reports*, who is interested in New Caledonia and has spent many years there, reports that the deposits of chromic iron ore are large. Recently, several American steamers, after discharging cargo at Sydney, went to New Caledonia to load chromic iron ore for the United States, providing a satisfactory cargo for the return trip.

The island is rich in nickel, lead and copper, and there are also gold, silver and coal. The climate, unlike that in some other South Sea Islands, is reported to be quite healthful. The soil is generally broken up by hills, the best agricultural lands being river valleys. The island is about 1000 miles from Australia.

Foreign Iron and Steel Trade

The following table shows the exports and imports of iron and steel and manufactures thereof for the month of May, as reported by the Bureau of Commerce. The first line shows the total value; the second line the value of machinery, included in the total; the third line the volume in gross tons, of those iron and steel products which are reported by weight:

	Exports		Imports	
	1916	1917	1916	1917
Total value	$72,918,913	$107,362,635	.....	.....
Machinery value	21,984,961	22,960,478	.....	.....
Iron and steel, tons	540,591	587,900	32,113	26,038

The decrease in tonnage imports was chiefly in ferromanganese and scrap. The increase in exports, both value and tonnage, over last year was large, but the totals were slightly below those of March of this year. The larger increases this year were in billets, ingots and blooms, and in steel plates and sheets.

Imports of special alloys in May were as below in gross tons:

	1916	1917	Changes
Ferromanganese	.....	2,019	.....
Ferrosilicon	417	1,144	I. 727
Nickel ore and matte	7,865	7,024	D. 841
Manganese ore	74,825	81,269	I. 6,444
Tungston ore	.....	404	.....

Ferromanganese and tungsten ore were not reported separately in 1916. Exports of ferrotungsten and tungsten metal this year were 207 tons; of ferrovanadium, 139 tons. Exports of nickel and nickel oxide were 806 tons, against 1622 tons last year.

Steel Production in 1916

The production of steel ingots and castings in the United States in 1916 is reported by the American Iron and Steel Association at 42,773,680 gross tons, which exceeded the make of pig iron for the year by 4,338,893 tons. Of the total last year, 41,401,917 tons were ingots and 1,371,763 tons direct castings.

In 1916, 174 works in 25 states and the District of Columbia made steel ingots, against 134 works in 20 states and the District of Columbia in 1915. In 1916, 230 works in 28 states, the District of Columbia and the Canal Zone, Panama, made steel castings, against 218 works in 27 states, the District of Columbia and the Canal Zone, Panama, in 1915.

The production for two years past has been, in gross tons, according to processes used:

	1915		1916	
	Tons	%	Tons	%
Basic open hearth	22,308,725	69.4	29,616,658	69.2
Acid open hearth	1,370,377	4.3	1,748,769	4.2
Bessemer	8,287,213	25.7	11,059,039	25.9
Crucible	113,782	0.4	129,692	0.3
Electric	69,412	0.2	168,918	0.4
Miscellaneous	1,527	.....	604	.....
Total	32,157,036	100.0	42,773,680	100.0

It is noteworthy that the production of ingots by the bessemer process shows a very large increase, the tonnage being 11,059,039, the largest output by this process since 1907, when 11,667,549 tons was made. The production by the openhearth process was by far the greatest on record. The crucible output was the largest since 1907, and the production by the electric process far exceeds that of any previous year, it being 168,918 tons in 1916, compared with 69,412 tons in 1915, which was the highest previous record. Included in the production of basic openhearth steel is the production of duplex ingots and castings, 3,436,457 tons, an increase of 1,654,926 tons, or 92.9% over 1915. The total make of alloy steel ingots and castings in 1916 was 1,362,615 tons, being 341,468 tons more than in the preceding year.

Steel production for 10 years past has been as follows, in gross tons:

1907	23,362,594	1912	31,251,303
1908	14,023,247	1913	31,300,874
1909	23,955,021	1914	23,513,030
1910	26,094,919	1915	32,151,036
1911	23,676,106	1916	42,773,680

The production of 1916 was the largest ever reported, exceeding that of 1915 by 10,622,644 tons, or 33%, and being far ahead of any previous year.

In 1916 the production of all kinds of iron and steel rolled into finished forms (including blooms, billets and axle blanks rolled for forging purposes and semi-finished products which were rolled for export in that year) shows an increase of 7,987,465 tons, or 32.7%, as compared with the output in 1915. The make of finished rolled iron and steel in 1916 is shown in the following table, in gross tons:

Products	Iron	Steel	Total
Rails	.....	2,854,518	2,854,518
Plates and sheets	13,303	7,440,677	7,453,980
Nail and spike plate	2,979	27,109	30,088
Wire rods	867	3,517,879	3,518,746
Structural shapes	1,823	3,028,141	3,029,964
Merchant bars	993,948	5,625,598	6,619,546
Bars for reinforced concrete work	2,683	458,717	461,400
Skelp, flue and pipe iron or steel	355,445	2,572,229	2,927,674
Long angle splice bars, tie-plate bars, etc.	77,656	614,164	691,820
Hoops	630	367,534	368,164
Bands and cotton-ties	.....	173,311	173,311
Rolled sheet piling, not including fabricated	.....	19,196	19,196
Railroad ties	.....	34,311	34,311
Rolled forging blooms, forging billets, etc.	549	2,015,411	2,015,960
Exports of blooms, billets, sheet bars, etc.	.....	512,483	512,483
All other finished rolled products	372,688	1,296,540	1,669,228
Total, gross tons	1,822,571	30,557,818	32,380,389

The production of galvanized sheets in 1916 was 1,346,924,950 lb.; of galvanized formed products, 130,302,195 lb.; total, 1,477,227,145 lb. This was a decrease of 216,609,851 lb. from 1915, due largely to the high price of zinc.

The output of tin plate was: Coke plates, 2,494,648,296 lb.; charcoal plates, 57,575,979 lb.; total tin plates, 2,552,224,275 lb.; terne plates, 214,176,952 lb.; total, 2,766,401,227 lb., an increase of 401,105,527 lb. over 1915. Exports of tin plates increased from 154,642 gross tons in 1915 to 227,391 tons last year.

The production of merchant bars show an increase of nearly 60%. This was largely due to the quantities of shell steel and shrapnel steel which came under the merchant-bar classification. The exports of steel bars were 774,455 tons last year.

The production of nails in 1916, in kegs of 100 lb. each, was: Wire, 17,147,665; cut, 764,835; total, 17,912,500. The total shows an increase of 2,554,147 kegs over 1915. Exports of wire nails were 3,363,876 kegs, an increase of 1,312,401 kegs over 1915; exports of cut nails were 106,451 kegs, an increase of 11,573 kegs.

The production of forged iron and steel by rolling mills and steel works in 1916 was: Iron, 3352; steel, 920,415; total 923,767 tons, an increase of 400,044 tons.

The production of hammered charcoal-iron blooms, billets, etc., was 80,685 gross tons, of which 5405 tons were made for sale and 75,280 tons for use of makers. The total was 37,504 tons more than in 1915.

The make of cast-iron pipe was 1,080,623 net tons; pipe fittings, 133,710 tons; total, 1,214,333 tons, being only 537 tons less than in the previous year.

The Selection of Gearing

By W. H. Phillips
Research Engineer, R. D. Nutall Co.

Alloy steels for use in gears had to be eliminated owing to their cost, and in consequence heat-treated carbon steel was developed to give the required results. There are three classes of heat-treatment—oil-quenching, casehardening, and a special process—each possessing adaptability to a certain class of service.

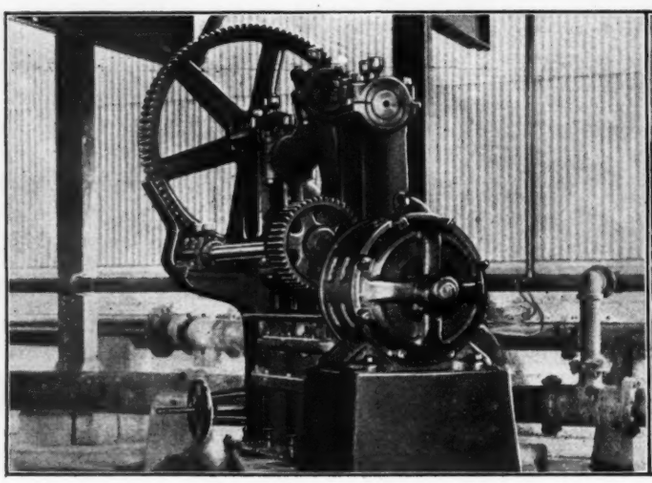
THE rapid progress made in the last few years in the manufacture of high-grade heat-treated gearing was necessary before certain industries, such as the automobile business, could develop. In certain other industries, such as electric railways, with their ever-greater carrying capacity, power and speed, the question of suitable gearing was also becoming serious. The increasing size of the motor, with the smaller available space for the gear, imposed greater loads on the gear material. The development of heat-treatment therefore has been highly beneficial to these industries, but the application should not stop here. The metal-mining field with its heavy and often excessive service, is an industry well suited to the use of improved gearing.

If by increasing the cost of gearing from 25 to 50% a gear is produced that will triple the life of the untreated-steel gear and at the same time eliminate the breakage with its consequential damage, there can be no doubt of its economy. A few of the advantages to be derived by such a step are: Lower ultimate cost of gearing; reduction of time loss; reduction of labor maintenance; reliability. Each broken or worn-out gear on a crusher in the mill, for example, will tie up the entire mill section waiting replacement of the gear. This will be the greatest loss, and after the cost of the new gear, the labor involved in replacing, the reduced production and the interest on idle investment are added, the ultimate economy of eliminating such waste will be sufficiently apparent.

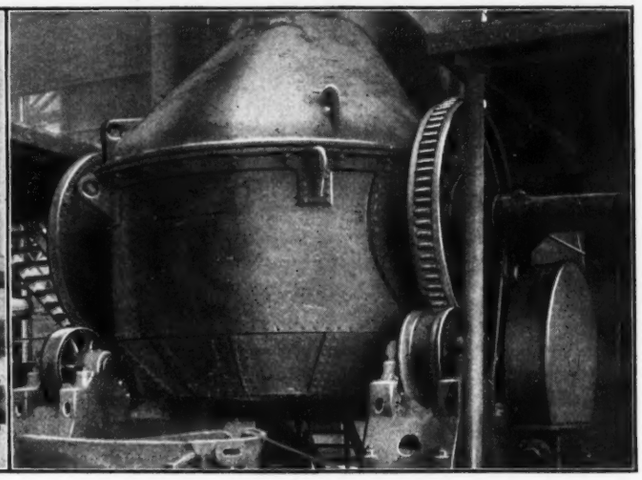
The untreated gear costs $10 and runs one year. The treated gear costs $15 and runs three years. This would show a saving of $15 on initial cost. If it requires two hours to make replacement, it would require six hours to replace the $10 gear three times, and but two hours to replace the $15 gear, or four hours saved in labor. Four hours would also be saved in production of the machine. The hazard of breakage, with its consequences, is an unknown factor, but may be serious in some services.

If it is true that there is an economy in the use of heat-treated gearing, the question naturally arises as to what is the proper grade for different conditions. This is a matter that should be given careful consideration, lest the wrong application is made and the results prove unsatisfactory.

Except where weight and space are important, alloy-steel gearing is not commercially practical because of its high cost. In the automobile field, where a comparatively small gear tooth must stand great strains, the strength and toughness resulting from alloying certain elements such as chrome vanadium, and nickel with steel, are very desirable, if not absolutely necessary. But this covers a comparatively small area of the gear field, and for the most part, heat-treated carbon-steel gearing is meeting every requirement imposed upon it and still has a great field for development.



RECIPROCATING-PUMP GEARING TO RESIST CONSTANT TORQUE



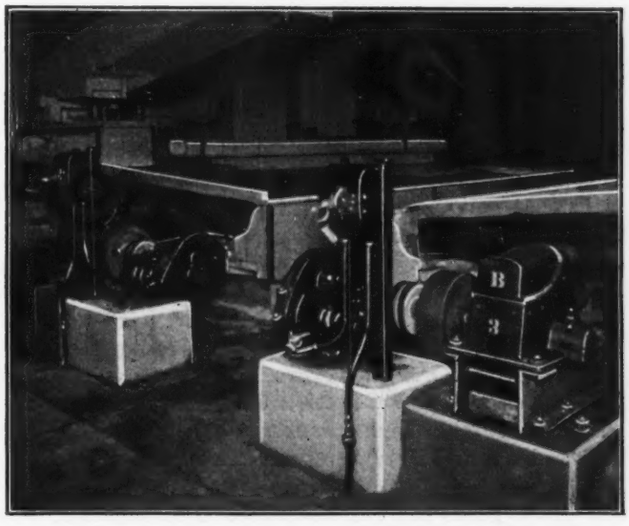
CONVERTER GEARING TO RESIST WIDELY VARYING TORQUE

Heat-treated carbon-steel gearing may be divided into three general classes—oil-treated, casehardened, and special-treated gears. The first two classes were introduced in the sequence given and have met many problems. Each has its advantage for different services and in this service has proved efficient. There are conditions encountered, however, in which these two grades are not applicable. The third class mentioned has been developed after a careful study of actual conditions and embodies the best qualities of both the former classes.

There are applications where the service is so light that the resultant long life and low maintenance cost

do not necessitate a high-grade product. There are other services where the gear must transmit a uniformly high torque without sudden jars or dynamic blows, in which case it is a question of wear alone, surface hardness as found in the casehardened produce being required. There are still other applications where the load to be transmitted is uniformly low but with occasional shocks. This last-named condition requires a gear with only medium hardness but with high ductility, such as the first class or oil-treated gear. There are installations, and these are in the majority, where the service imposes the heavy duty with its resultant wear as well as shocks with the liability of breakage. This is especially true in concentrating-mill and smeltery work. It is for such service that the third class or special grades of gearing have been developed. By analyzing the conditions and selecting the proper grade it will be possible to obtain the best results.

Before considering the three classes of gearing, comparing and explaining the properties of each, it will be well to explain briefly how gearing is manufactured to insure equality and uniformity of product.



CONCENTRATING-TABLE MOTOR, GEARING ENCLOSED

The old-fashioned eye pyrometer and rule-of-thumb methods of heat-treatment used a few years back have given place to the modern treating department with its closely regulated furnaces and accurate temperature-recording instruments. Poor heat-treatment is worse than no treatment at all, often leaving the steel coarse-grained and brittle. The laboratory that must be maintained in conjunction with the treating department gives the exact analysis of the gear to be treated. Today, knowing the chemistry, the method of procedure becomes an exact science with the uncertainty and doubts removed.

Physical Tests for Gear Steel

One or more gears in every lot of 100 should be taken for physical test, the test, when size permits, being taken from the root of the tooth. This test should conform to the A.S.T.M. standard 2-in. pulling test giving tensile strength, yield point, elongation and reduction. This testing of one gear in every lot of a hundred or fraction of a hundred does not necessarily insure uniformity There may be one or more gears that, owing to one cause or another, have not come up to the required standard. As a check on each gear, the Brinell hardness test may be used, the advantage of this method being that it does not deface the gear to any extent, yet is thorough and reliable. Briefly, it consists in pressing a 10-mm. ball into a flat surface of the steel at a constant pressure of 3000 kg. and measuring the diameter of the impression with a scale magnified and graduated to one-twentieth of a millimeter. As a result of many thousands of these tests, a good working knowledge of the tensile strength of the steel can be obtained. By the Brinell method each gear is tested on the opposite sides of the periphery, it being known what the hardness should be within a certain range. The gear is rejected if the hardness is without this range. In this way a high uniformity may be obtained. This is the most reliable, practical and most widely used hardness test known, all variables except the hardness of the steel itself being eliminated. Therefore, when gearing has been analyzed, properly treated and tested, its conformance to the required specifications can be depended upon.

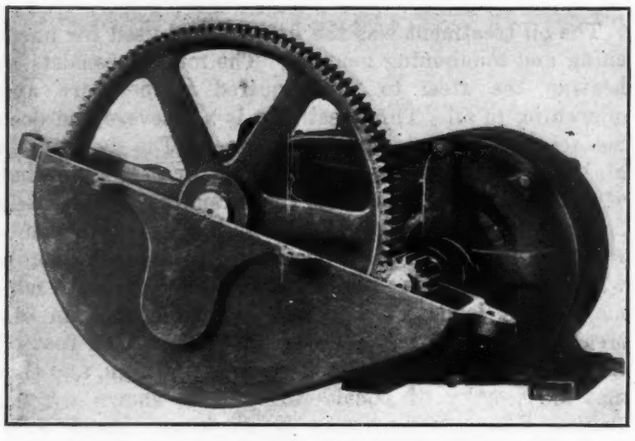
Oil Treatment and Casehardening

The oil treatment was the first method used for hardening and toughening gearing. The method consists in heating the steel to the required temperature and quenching in oil. This treatment is not severe and does not set up heavy strains in the steel. The ductility is high, but the hardness only slightly greater than that of untreated steel, as is also the strength. Where it is desirable to increase the hardness and strength somewhat and retain a high ductility, or in other words, when the gearing is to be subjected to shocks with normally light loads, ductility is important, and an oil-treated gear may be advisable. The increased cost of this grade over the untreated grade is not high, and this may be worthy of consideration. As shown by the Brinell test, the hardness is increased about 75% While this may seem to be a very material increase by comparison, it is relatively small. The oil treatment may be applied to forged or cast-steel gears.

The casehardening process consists essentially of a high-carbon case backed up by a low-carbon core. A low-carbon steel is used, the high-carbon case being obtained by treatment. The depth of this case can be controlled, giving any penetration desired. This treatment has been known for a long time, but it has been applied to gearing only in recent years. Comparing the hardness of the case and core with that of untreated steel, the case is found to be four times as hard as untreated steel, while the core is only slightly if any harder. When the service is such that heavy shocks do not occur and all the gear must do is transmit uniform load, the very hard case of this product resists wear well and the gear will have a long life. When, however, the load to be transmitted is variable and there is liability of heavy shocks, the case will get this strain first and being very brittle will tend to fail. This treatment is somewhat more expensive than other grades as it requires at least five applications of heat to properly harden a gear. Care must be exercised in handling and installing this gear as the case will be spalled off by a slight blow. It is desirable also, in order to secure maximum life, that it be run in both directions to utilize the benefit of the case on both sides of the tooth.

With the steadily-increasing knowledge of steel and of the methods of heat-treatment year by year, the oil-treated and casehardened grades have been improved gradually until now they have been perfected as far as possible, and the metallurgist for some time has been looking to other fields for a grade that would include the good qualities of both, supply what they lacked and, if possible, reduce the cost of the heat-treatment. As stated before, the alloy steel had to be eliminated owing to its cost, and the only course left was to develop a treatment for carbon steel that would give the required results. Several of these so-called special grades were introduced, one of the more notable being the BP grade manufactured by the R. D. Nutall Co., of Pittsburgh, Penn.

It was found that by slight changes in chemistry a combination could be obtained which, when subjected to a special treatment, produced physical properties adapted to gearing. The hardness at the surface of the steel is from three to four times that of untreated steel, and grades off slightly toward the center of the tooth until it is from two and one-half to three times as hard as untreated steel. This reduction in hardness is in a straight-line ratio and each fiber of the steel from the surface to the center or neutral axis of the tooth, which may be slightly to one side of the geometric center, will be stressed in proportion to its ability to carry the load, so that, when the tooth receives a blow or shock, every fiber is carrying its share of the load. The ductility of this steel is comparatively high and is in inverse ratio to the strength. The metal is homogeneous, there being no line of demarcation between any two fibers. While the surface of the tooth is hard, yet it is of a tough hardness and will not shock or spall. It is often advisable to treat the pinion only of a combination, it being the weaker and hardest-worked member. A pinion so treated, owing to the nature of the hardness, is not liable to cause excessive wear on the meshing untreated gear. It can be seen readily that a gear of this type, which is of moderate price, will have a great tendency to overcome breakage and at the same time give a high resistance to wear. It should triple the life of untreated gearing and eliminate the cost of consequential damage and delays caused by gear breakage.



CONCENTRATING-TABLE MOTOR, GEARING EXPOSED

Very often gears are designed with no intention of ever being heat-treated, and may be so flimsy in certain sections that it would be impossible to submit them to the strains necessary in heat-treatment. These gears, however, are intended for light service and usually give no trouble if untreated.

The effect of dynamic blows on spur gearing when running at high speed and transmitting heavy loads, while it has never been accurately ascertained, is known to be great, often excessive, and in such service forged steel should be used whenever possible.

The wide application of the heat-treated gear not only in the railway and automobile field, but also in many branches of the industrial field, among the more notable being the steel mills, smelteries, concentrating mills and mines, has been so successful that it is not a question of heat-treated versus untreated gearing, but rather the selection of the proper grade of treated gear for the service to be performed.

Mine, Mill and Smeltery Applications

Upon analyzing the gear requirements for mine, mill and smeltery applications, the following inherent characteristics are apparent and the grades of gear best suited to such service are suggested:

Mine service: For hoists reliability is of paramount importance, requiring a gear with great resistance to breakage. Herringbone units are recommended. For locomotives constant torque and reduction of maintenance are important, requiring a gear offering resistance to wear yet tough enough to stand up under conditions that necessarily prevail in mine-locomotive operation. Special grade gears are recommended. For reciprocating pumps constant torque and reduction of maintenance are important, requiring a gear of hard wearing surface. It does not, however, have to resist heavy shocks. Casehardened gears are recommended.

Mill service: For conveyors and elevators constant torque, location and reduction of maintenance are important. Casehardened gears are recommended. For rolls and crushers heavy shock and reduction of time loss are important. A tough, strong gear is required. Special grade gears are recommended. For tube and ball mills heavy vibration, reduction of time loss and maintenance are important. Special grade gears are recommended.

Smeltery service: For cranes widely varying torque and reduction in maintenance are important. Special grade gears are recommended. For converters widely varying torque, reliability and reduction of maintenance are important. Special grade gears are recommended. For casting machines heavy shocks, reduction of maintenance and time loss are important. Special grade gears are recommended. For blowers constant torque and reduction of maintenance are important. Casehardened gears are recommended. It must be borne in mind that these suggestions as to the grades to be used in the different services may be varied with special conditions, but in general the applications will be found to be satisfactory.

In conclusion it might be well to state that with many industries of the country working over capacity, the necessity for reliability of machine parts was never before so great, or the consequences of breakdown so costly. A careful study of the gear situation in the plant or mine should be made therefore at this time, and any changes necessary to insure reliability made at once.

An Opportunity for Engineering Service

The war has interrupted the supply of many mineral that were normally imported. In view of present transportation conditions a serious shortage exists in certain materials and will soon develop in others. Some immediate action is imperative. The first thing is to take a careful inventory of American resources. We must know where the ore deposits are, what has hitherto hindered their utilization, what methods must be used, and what equipment will be needed if an emergency demands their rapid development.

Many properties must be reëxamined from a new point of view—that of present necessity rather than of normal profit. When the shortage is realized, the preliminary steps for relief should have been completed. It is a necessary and patriotic form of mineral insurance.

Do not forget that these are war times and that what may have been valueless a year ago may be a "life-saver" now. An abandoned copper prospect of 1913 might make a successful pyrite mine in 1917. We are fighting an autocratic enemy who knows his resources to the last pound and uses them with most efficient organization. We have no Kaiser, so each of us must do his share to put our Government in the same situation. The Government needs your facts.

Part of this essential information is contained in the mining reports in your files. The following minerals are of special importance: Pyrite and pyrrhotite east of the Rocky Mountains; sulphur, manganese and manganiferous iron ore, lead, nitrate, chromite, tin, nickel, platinum, flake graphite, sheet mica, and high-grade refractory clay.

Will you submit a list of the reports (or the reports themselves, if you prefer) which you have on properties and deposits that may be of importance under the present abnormal war conditions? Give the date of the report, the name of the engineer who made it, the type of ore, the precise location of the deposit, and its relation to transportation. On request, will you lend these reports for the use of the War Minerals Committee, or such appropriate department of the Government as you may specify? Reports will be held confidential if you so indicate. Can you donate a certain amount of service to the further examination of properties which may be selected as of greatest importance? Address, The War Minerals Committee, Room 4241, Interior Department Building, Washington, D. C.

The members of this committee who have been designated by their respective organizations are as follows: William Young Westervelt, consulting mining engineer, chairman representing the American Institute of Mining Engineers, and the Mining and Metallurgical Society of America; Alfred G. White, mine economist, United States Bureau of Mines; W. O. Hotchkiss, state geologist of Wisconsin, representing the Geology Committee of the National Research Council and the Association of State Geologists; David White, chief geologist, United States Geological Survey.

This committee has, as its specific purpose, the consideration of the development of a sufficient supply of those minerals of which a scarcity now exists or may develop. It is intended to promote united action by the mining and geological professions as represented by Federal and state bureaus and the mining societies, and to secure the effective service of such individual engineers and geologists as desire to be of assistance.

Negligence as Element of Liability

BY A. L. H. STREET*

In reversing judgment against owners of a mine in the Joplin district, awarded by the trial court in favor of a shoveler who was injured at the bottom of a stope through fall of rock and dirt from the roof, the Springfield, Mo., Court of Appeals holds that if the employers did all that a reasonably prudent man could be expected to do in the circumstances, by preparing a level place at the top of the stope to catch any fall of overhanging dirt or rock, liability for the accident could not be predicated on failure to timber the roof. (Neeley vs. Snyder, 193 Southwestern Reporter, 610.)

Foreign Trade in Lead and Zinc

Imports of lead and zinc during March and April, 1917, are reported by the Department of Commerce as follows:

Articles and Countries	March Contents, Lb.	April Contents, Lb.
Lead Ore:		
France	64,692	.....
Canada	3,057,064	1,029,317
Colombia	1,781	.....
Salvador	428	.....
Mexico	2,197,645	1,370,087
Chile	.....	1,142,854
Peru	4,785	86,393
	5,326,395	3,628,651
Lead—Base Bullion and Bullion:		
Mexico	6,870,205	6,953,531
Lead—Pigs, Bars, etc.		
France	69,710	.....
Panama	8,453	9,989
Barbados	.....	567
Colombia	1,054	.....
Haiti	37,052	1,882
Canada	.....	1,500
Guatemala	.....	52,400
	116,269	66,338

The gross weight of lead ore imported was 6357 long tons.

The actual tonnage of zinc ore imported in April amounted to 14,696 tons. The countries of orgin and the metal contents were as follows:

Countries:	March Contents, Lb.	April Contents, Lb.
Canada	665,000	145,000
Australia	6,650,000	.....
Mexico	13,631,418	10,487,907
	20,946,418	10,632,907
Zinc in Blocks, Pigs, etc.:		
Costa Rica	3,611	250
Panama	6,998	2,291
Cuba	68,111	16,488
Mexico	3,308	.....
Brazil	4,345	.....
Ecuador	.....	7,580
	86,373	26,609

Imports of zinc dust amounted to 67,287 lb. in March, 1917, and to 134,398 lb. in April.

Exports of lead and zinc were as follows (in pounds):

	March	April
Lead:		
Pigs, bars, etc., produced from domestic ore	7,488,872	6,907,870
Pigs, bars, etc., produced from foreign ore	1,671,469	4,764,621
Zinc:		
Pigs, etc., produced from domestic ore	32,995,927	22,442,083
Pigs, etc., produced from foreign ore	16,460,533	6,495,603
Sheets, etc.	1,819,556	2,907,345

*Attorney at law, 829 Security Building, Minneapolis, Minn.

Details of Practical Mining

Slope Cut-and-Fill Method of Mining

BY JOSEPH P. HODGSON
Mining department, Phelps Dodge Corporation, Bisbee, Ariz.

The stoping method discussed in this article is one that is particularly applicable to hard sulphide orebodies in copper or iron mines where waste filling is an absolute necessity for the safety of the men and the property. Since the cut-and-fill method is often used as "cutting and filling" on the horizontal, or in combination with shrinkage, it will be referred to in this paper as the slope cut-and-fill. A concrete example has been selected of a typical stope which is in operation in one of the larger mines of the Southwest, and the outline of its different stages may be enumerated as follows:

A main haulage drift is first driven through and around the edges of the orebody, as illustrated in

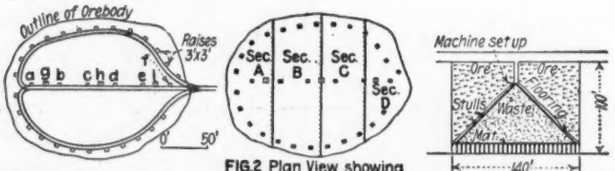


FIG.1 Plan View of Orebody (150'x200') Sill Floor

FIG.2 Plan View showing Sections or Ribbons of Ore, First Stoping Floor

FIG.3 Vertical Section A Lengthwise

METHOD OF SPACING STOPE FOR CUT-AND-FILL METHOD OF MINING

Fig. 1. The fill or waste raises *a*, *b*, *c*, *d*, *e*, and *f* are next put up to the level above. Then the two-compartment, cribbed, service raises *g*, *h* and *i*, Fig. 1, are carried through the fill as stoping progresses. The purpose of these three raises is to provide ventilation, manways and room for handling tools and supplies. The ore chutes are 25 ft. apart and are situated around the edges of the orebody.

After the main-level drifts, raises and chutes are finished, stoping operations are begun on the first stop-

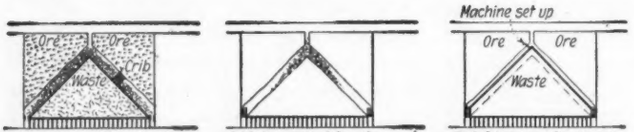


FIG.4 Vertical Section A Lengthwise

FIG.5 Vertical Section

FIG.6 Vertical Section A Lengthwise

SECTIONS SHOWING METHOD OF OPERATING BY CUT-AND-FILL METHOD

ing floor, shown in Fig. 2, the sill being left until another stope is brought up from beneath.

In Fig. 2 the stope is in the producing stage. Grizzlies of 40-lb. rails are put over the different ore chutes for safety, and the ore is blasted down. The chutes are drawn and stoping operations continued until the back of the stope is about 15 ft. high. The broken ore is then cleaned out and a floor of plank or split poles is laid, which acts as a mat between the ore left in the stope sill and the waste filling. Also partitions consisting of rows of stulls with lagging may be put in, dividing the stope into four or more sections, if considered necessary as shown by *A*, *B*, *C* and *D*, Fig. 2. These stulls and lagging provide a partition between sections and hold the waste fill in place, one section being carried ahead of the others as stoping proceeds.

The work is so arranged that two sections are producing while the remaining two are being filled with waste. Drilling machines are set up near the raises (*a*, *b*, *c*, *d*, *e*, *f*), and "ribbons of ore" are cut downward along the sections to the limits of the orebody. The largest cuts are made along the major axes of the orebody. The ore is drawn out through the raises (*g*, *h*, *i*) and the ore chutes. Waste is turned in from the level above and allowed to fill the stope until it is within 3 ft. of the back; then flooring is laid on the waste again and machines set up for drilling. The stages of carrying up section *A* are illustrated in Figs. 3, 4, 5 and 6. In Fig. 3 waste has been turned in until it is within 3 ft. of the back. A floor has been laid and the machine set up ready to drill and make the next cut. Several short stulls have been put under boulders. Fig. 6 shows the stope ready for the next cut of ore.

The work in sections *B*, *C* and *D* is a repetition of that done in section *A*. The service raises and chutes are always built up before waste is turned into the stope. After the stope is carried up far enough to be on the slope, there is practically no mucking.

Where local conditions will permit its application, the method described is the most advantageous of any of the cut-and-fill systems; it is safe, the miners working at all times close to the backs, and being on the slope, the stope backs in almost all cases are stronger, it is very elastic, as the crib raises may be inclined in any direction as they are carried through the filling in the process of stoping, in case the ore should bear in one direction or the other; it is economical, as the costs of filling are reduced to a minimum; it produces the least amount of dust, as water machines are used instead of stopers. The costs of handling ore are low, and each mucker can handle a comparatively large tonnage per shift, while the amount of timber used per ton of ore extracted is exceedingly small.

Prevention of Rope Jamming on Drum

BY HALE H. HUNNER*

The rope used was second-hand, ½ in. in diameter and had several kinks that made it impossible to get a perfectly smooth wind when reeling it on the drum. The kinks were pounded out as much as possible when the rope was first put on. After a few shifts the rope had crowded over enough to cut into the layer below, badly mashing the strands, which would have been ruined in a short time.

*Nashwauk, Minn.

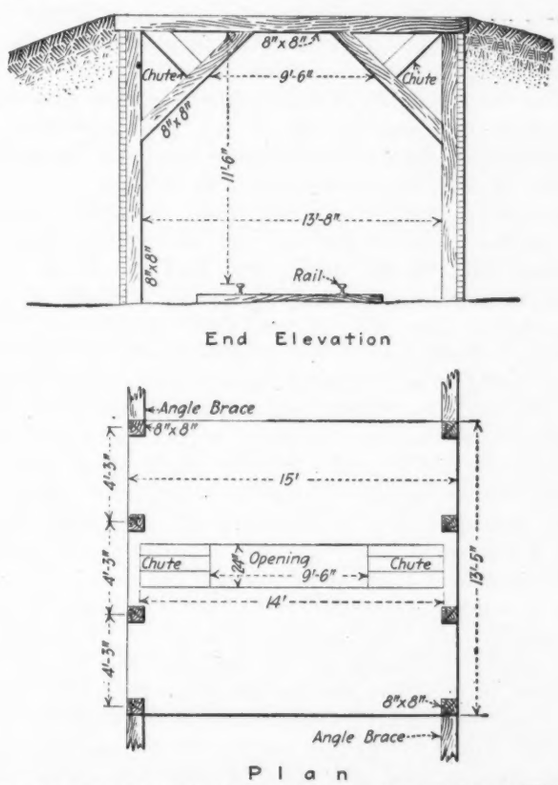
The drum was unwound and rewound, care being taken to drive each loop snug against the last. Where a kink occurred in the rope, a little space was left on either side, which was sufficient to allow the rope to cut in on the lower layer. After a few days' operating, the rope was again rewound and a sheet of galvanized pipe covering was cut the width of the drum and long enough to cover the under layer of rope and lap about one inch. The sheeting was put on as the rope was starting back from the end of the drum, and as soon as two loops had covered the sheeting, the other side was drawn up tight with a loop of hay wire. The rope cut into the sheeting about one-eighth of an inch and never gave any more trouble.

When the shaft was deep enough to use the layer of rope below, the sheeting was removed and placed over the next layer on the drum.

Wagon-Dump Trestle Over Railroad

BY ALBERT G. WOLF*

In hauling ore to the railroad in wagons a considerable saving in time and expense can be effected if, instead of having to shovel the ore, facilities are provided for dumping directly into gondolas. The construction of such a dumping-trestle in details is shown in the illustration. The 8 x 8-in. posts, caps and angle braces furnish a sufficiently strong structure for any



DETAILS OF LOADING PLATFORM OVER RAILROAD TRACK

wagon load that may be hauled upon it. The general dimensions may be varied somewhat to suit different conditions, but care must be taken to allow sufficient width and headroom. The opening in the floor, 2 x 14 ft., is long enough and nearly wide enough to catch all the ore as it falls from the wagon, and permits the team to be driven astride the hole. The small amount of ore which falls along the sides of the opening can easily and quickly be pushed in with a shovel. The chutes at either end of the opening should be steep so that no ore will stick, and the lower ends of the chutes should not be over 9 ft. 6 in. apart for standard-gage cars. Approaches will have to be built up in a level country; dirt-fill is probably the cheapest and most satisfactory in the long run. If a railroad cut is conveniently situated this expense in construction can be saved.

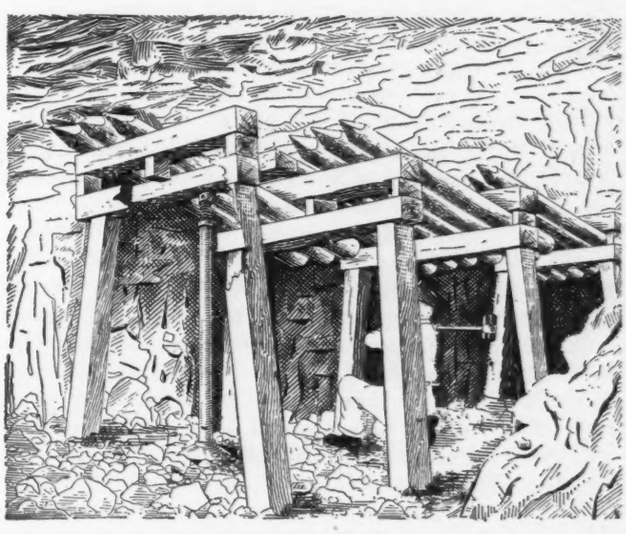
[In many parts of the country it is illegal to build a loading platform over a railroad track, even over a switch on private property. An approach to sufficient height to load a gondola car and comply with height of headroom required by the railroads would cost the equivalent of many car loadings.—Editor.]

*Mining engineer, Denver, Colo.

Drifting with a Drill Column

BY ALGERNON DEL MAR*

It is usual when drifting through caved ground to drive lagging ahead under the bridge in the cap of the tunnel set and to support this lagging with a false set until enough ground is excavated to place the regular set of timbers with cap and bridge for further work. If the pressure is mainly from above, a drill column may be used in place of the false set with a saving in



METHOD OF HOLDING FALSE CAP WITH DRILL COLUMN

time, for all that is necessary is to put a headboard sufficiently long to reach across the drift on top of the drill column and screw it tight. When enough dirt has been taken out to place the tunnel set and this has been put in place with cap and bridge, the jackscrew on the column is loosened and the lagging drops on the bridge. The sketch will make this method sufficiently clear. Instead of hammering the lagging in, the same drill column (before being used as a false set) may be used to force the lagging ahead. Some prefer to point the lagging with a chisel edge, while others will use a pencil point. The bridge may be supported on the cap in two or more places according to the pressure on the bridge. The sketch shows a drift and the column in use.

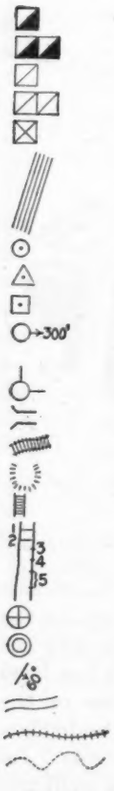
*Dewey Mine, Gazelle, Calif.

Correspondence and Discussion

Standard Map Conventions

In the *Journal* of Nov. 25, 1916, E. B. Wood suggested that the adoption of a set of conventional designs for maps would be an advantage. I agree with him. How much more convenient it would be in learning the workings of a mine new to one to be sure of the meaning of the various conventional signs on the maps without having to ask the surveyor. Again, it may be the case that at different periods of the mine's life different surveyors were employed, who each used different signs for the same thing. What is still more confusing is to find on a map the same design used for more than one kind of mine working; for example, note the confusion in mind when raises and winzes extending from the same level are represented by the same sign. Worst of all, some surveyors, either through carelessness or ignorance of what a map should show, fail to indicate all the mine workings. A list might easily be compiled that would show all the usual features at a glance.

SUGGESTED MAP CONVENTIONS



Single-compartment shaft or winze.
Double-compartment shaft or winze.
Single-compartment raise, vertical.
Double-compartment raise, vertical.
Ore chute, or mill hole.
Incline shaft, raise or winze (used in connection with above signs at points where incline holes through).
Survey station.
Triangulation station.
Bench mark.
When level too long for map, last station indicated thus, and distance shown by figures.
Claim corner.
Adit or tunnel portal.
Mine track on surface.
Dump.
Ladderway.
Plan of drift with sample cuts; 1 and 2 across back, 3 and 4 vertically on wall, 5 horizontally along wall.
Churn drill hole.
Diamond drill hole.
Fault or slip, showing dip.
Road, two parallel lines.
Railroad.
Trail.

In choosing a list of standard conventions, it is important not to have too many signs. I have in mind a list proposed by one surveyor, which contained about seventy designs and required a dozen or more colors. Such a list is of no value. In the first place it is impossible to remember all the signs and what they represent, and the colors are useless, for in making prints the value of a color in differentiating is lost and some colors will not reproduce at all. A set of standard map conventions to be of the greatest value should include only such as represent the most common, and therefore most important, features of the surface, underground workings and surveys, and should be entirely in black.

The accompanying list is a tentative suggestion for a set of standard map conventions. With the exception of the fault line, no attempt has been made in this list to cover the field of geological features, for on most geological maps and sections the use of a legend is necessary. Other engineers may consider some of these signs of too little importance to be included in any standardized set, while they may have additional signs to suggest. It is a matter of opinion, and therefore open to discussion.

ALBERT G. WOLF.

Denver, Colo., June 24, 1917.

Fires in Mines

In the article, "Cementation as Applied to Mining," in the *Journal* of July 7, as well as in the original article by Mr. Blandford from which the abstract was made, the process of cementation has been referred to as being applicable to the sealing off of fire zones in mines. In a number of districts where mine fires have occurred, the sealing off of the fire zone has, if accomplished, been unsuccessful in attaining its desired result; that is, the extinguishing of the fire.

Assuming that the combustible material consists of sulphides and oxides of iron and copper and old timbers, etc., in old stopes, and that the whole mass could be hermetically sealed so as to exclude all air, the chances are nine to one that combustion would continue indefinitely, as the sensible heat of the burning mass would in all probabilities be sufficient to "crack" the oxidized ores throughout a part of the zone, furnishing more than the necessary oxygen to sustain combustion in the sulphides. This might mean that it would require decades to stop the combustion. Sulphur, while inflammable at a comparatively low temperature, will not burn at 212°, nor will it combine chemically with oxygen at that temperature. The heat of formation of sulphur compounds is well above the temperature of steam under any normal pressure. Therefore, if the sensible temperature of the fire zone should be reduced to less than the oxidizing temperature of sulphur and the cracking temperature of the oxidized ores, the fire would extinguish itself. If, for example, two holes were drilled into the hot zone and water were pumped into one and steam forced out of the other, each pound of water at 212° would absorb about 1000 B.t.u. of sensible heat. When sufficient sensible heat had been extracted, combustion would cease. In fact, the sulphide ores are not, in all probability, burning in the ordinary sense, but the "fire" is chemical, pure and simple. Therefore it is necessary

to reduce the temperature of the mass to below the critical point at which the reaction begins or continues to take place.

What the cooling effect in such an operation can be, no one could attempt to estimate, nor could an estimate be made as to how many B.t.u.'s need be extracted from the zone to extinguish the fire, but with known conditions the calculation could be made.

The steam which would emanate from a well, upon condensation could be used again and, even if it eventually became concentrated H_2SO_4, its power of absorption of heat would still be about 600 B.t.u. per pound.

Philadelphia, July 10, 1917. WILLIAM JONES.

Danger in Brass Carbide Lamps

Some time within the last two years I have noticed several articles in the technical press dealing with the subject of danger in brass carbide lamps, as a result of someone's suggestion that he had once heard that brass should not be used for acetylene lamps. According to my recollection, the Bureau of Mines investigated the subject and reported that it had been unable to demonstrate any good reasons why brass should not be used for this purpose. Hence the following incident, observed and tested by me may be of interest:

A man in the course of cleaning his lamp picked up a soft-iron spad and began to scratch off the deposit that had formed on the bottom of the water compartment, which, by the way, was already as clean as careful scraping with pieces of wood could make it. At the very first scratch made with the blunt end of the spad, a large smoky yellow flame, comparing favorably in size and color with that of the common wax match used in Cuba, burst forth.

Upon further investigation it was found that a dense-black scale, probably not over 0.01 in. thick, which covered the bottom of this water compartment, would yield large, fat sparks resembling those obtained from the iron selenide sparking alloy, whenever scratched with the head of the soft-iron spad, but no sparks could be obtained by scratching with the point.

After clearing away a considerable area of this deposit and repeating the test on the really clean brass, no suggestion of a spark could be obtained. In the absence of means for further investigation we concluded that the deposit was carbon which from recent use of the lamp was sufficiently charged with absorbed acetylene gas to ignite under the conditions described. Other lamps which showed analogous conditions, except, that they had not been used recently, failed to yield sparks when such deposits were attacked.

These lamps were all of brass and had once been galvanized. We were unable to attribute the sparks to the brass, but it may possibly be proved that such deposits do not form upon metals of lower heat conductivity.

JOHN B. STEWART.

National City Bank Building, Havana, Cuba.

Tube-Mill Practice in Rhodesia

In the *Journal* of Mar. 17 there is an article by A. W. Allen, on "Tube Mill Practice in Rhodesia," in which he makes disparaging reference to the work done by Komata liners as compared with El Oro liners. I would have replied to this criticism earlier, but have been awaiting answers to inquiries as to who supplied this particular liner, and find that it must have been obtained outside of any accredited agents and is probably not correctly designed for the work it is doing at the property in question.

The remarkable success of the Komata liner in the United States and other countries shows that it can hold its own against any other type. A few years ago some careful tests were made at one of our leading Western mines to ascertain the relative cost and efficiency of the Komata and El Oro liners. Tube mills 4 ft. 6 in. diameter by 20 ft. long were used and the following data obtained:

The first cost of the two types of liners is about the same, but the Komata shows very much less wear of metal than the El Oro. Power consumption with the Komata liners is slightly above that of El Oro liners, but the actual work done with the Komata is considerably greater than that done with the El Oro, as shown by the following tests:

TESTS OF EL ORO AND KOMATA LINERS IN TUBE MILLS

	El Oro		Komata	
Mesh	Feed	Product	Feed	Product
28	14.6%	0.6%	18.5%	0.1%
35	13.7	2.3	16.8	0.7
65	38.7	11.4	35.3	11.6
80	7.3	5.5	8.0	8.4
150	18.1	37.5	15.5	35.5
280	5.3	15.1	3.7	18.5
—280	2.3	27.6	2.2	25.2
	100.0%	100.0%	100.0%	100.0%

Silver City, Idaho, June 13, 1917. F. C. BROWN.

Gold-Bearing Quartz on the Saramacca River, Dutch Guiana

While attention has heretofore been directed mainly to placer mining, gold-bearing quartz veins are known to occur in Dutch Guiana, South America, and several attempts have been made to develop them.

Rich ore has now been opened up by the Janapau Gold Mining Syndicate on the Saramacca River, samples taken over the reefs showing as high as 34 oz. Au per ton. The distance from Paramaribo, the capital of the colony, to the district is short; the government railroad runs up to a point on the Saramacca known as Kwakoegren, from where the landing proper is but a stone's throw. This trip from Kwakoegren can be made by means of steam launches in three hours, making the whole trip up the river from Paramaribo in seven hours.

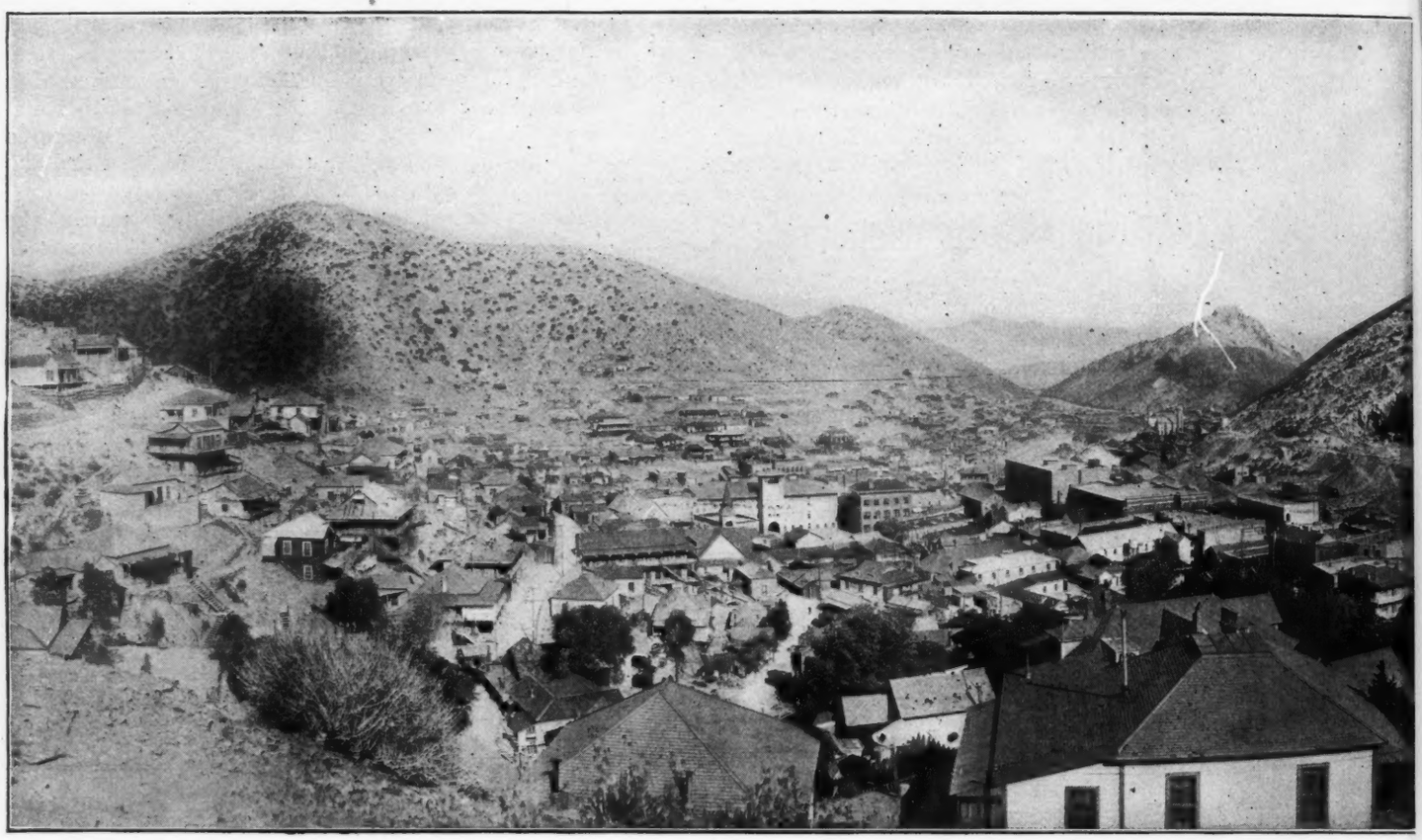
There is at present, according to the manager's report, 20,000 tons of ore in sight already developed and in shape for milling.

The syndicate, which is purely a local one, has a capital of $20,000 in shares of $20 each; a great deal of the stock has already been taken up, but this amount it is anticipated, will be inadequate for what is actually required to install an up-to-date milling plant and for working expenses.

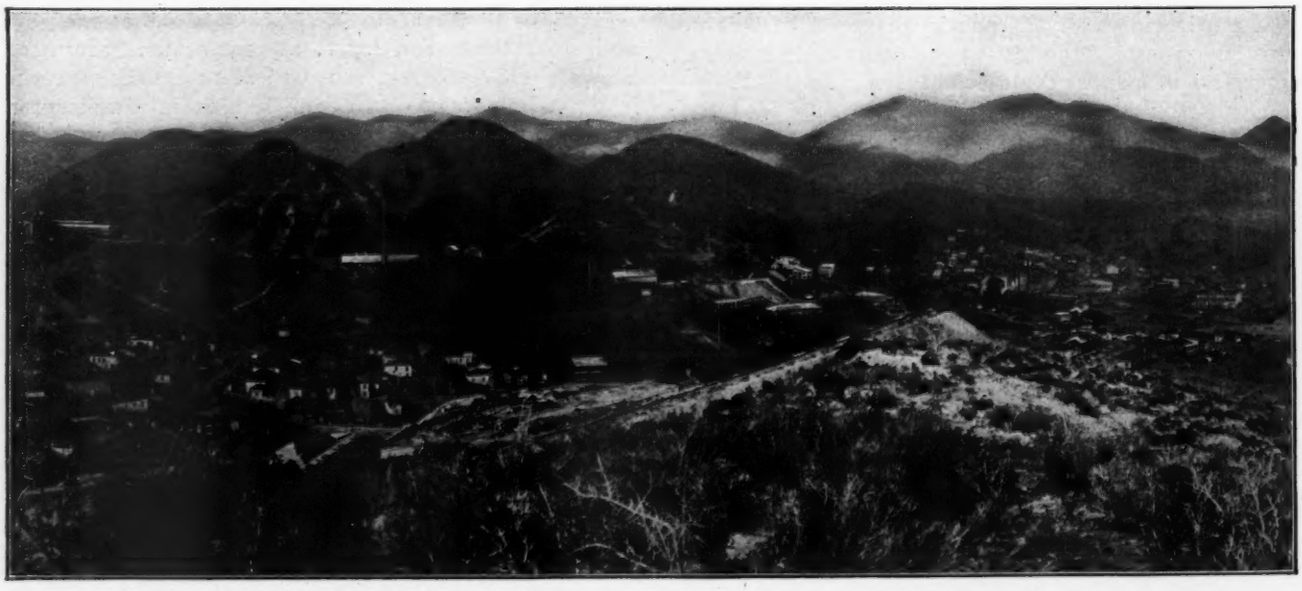
It has been suggested to erect the plant at the water front or landing, to have a light tramway line laid down for transporting the ore and to establish headquarters for the staff at this point. Water is in abundance the year round; fuel in the form of forest timber is almost unlimited. J. B. PERCIVAL.

Paramaribo, Dutch Guiana, June 12, 1917.

Bisbee, Arizona's First



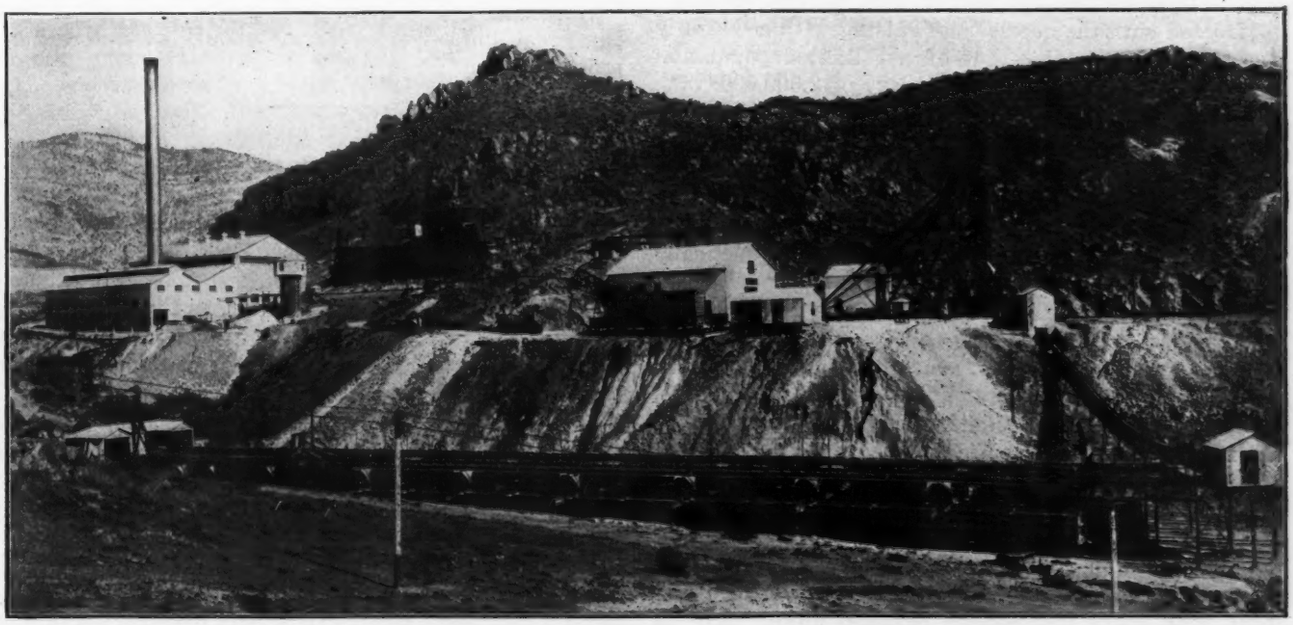
TOWN OF BISBEE, RECENTLY
This view shows the residential section, the famous Sacramento Hill (and the stacks of the old



LOWER PART OF BISBEE DISTRICT, SHOWING GARDNER MINE, LOWELL MINE, SACRAMENTO HILL (IN BACKGROUND), C. & A. JUNCTION SHAFT (RIGHT CENTER) AND C. & A. HOSPITAL

Great Copper District

CONVULSED BY I. W. W. TROUBLES
smelting works) in the centerbackground and the familiar road up Tombstone Gulch at the right



SACRAMENTO HILL, WHERE LOW-GRADE DISSEMINATED ORE IS NOW BEING MINED BY THE COPPER QUEEN COMPANY; SACRAMENTO SHAFT AND LOADING STATION IN FOREGROUND

Events and Economics of the War

The drawing of men for the draft army overshadowed in importance all other events of the week. Preparations are now under way for the speedy examination of those drawn. The Food Bill finally passed the Senate but in a form that is said to be objectionable to both the House and the President. The $640,000,000 Aviation Bill, the largest single appropriation ever made, is now law.

The need of ships has been impressed upon the country. The removal of Denman, followed by Goethal's resignation, relieves a situation that long since had become serious.

Abroad, the British Cabinet has undergone another shape-up. Treason and ignorance have caused a temporary collapse of the Russian offensive. The new German Chancellor failed to indicate in his speech any possibility of change in the imperial policy.

Business Expansion Possible Under Federal Control

The effect upon business of Federal control is discussed by the National City Bank in the last issue of its publication, *The Americas*. England's achievement in regulating its industries is cited as an example of what we may do.

"As to war-time conditions," says the City Bank, "we see Great Britain with its population of 46,000,000 (comparing with our 104,000,000) and its manufacturing capacity estimated to have an output of about eight billions' worth of product a year at the beginning of the war (comparing with a 1914 capacity in America of over $24,000,000,000 and now at least $29,000,000,000), confronted with the necessity of raising with emergency speed 5,000,000 soldiers out of her limited population (as against our present expected levy of 2,000,000, with talk of a final 5,000,000 out of our more than twice as many inhabitants) and with the economic burden of manufacturing immense stores of munitions with a national industrial plant a third the size of our own, in the face of a draft of so high a proportion of her working forces, and of the necessity of importing practically all of her raw materials.

"Yet, handicapped by a collapse of the machinery of international credits and exchange, so vital for her necessity of getting materials, confronted also with other critical problems from which we are absolutely free, Great Britain has so organized that the production of her industry is enormously increased despite the draft of men for war, internal prosperity is general, and a consistent policy of keeping up the foreign commerce of the country has been astonishingly successful.

"This has been done by means of a progressive government control that has now reached a degree of direct touch with every inhabitant's personal affairs that, in August, 1914, almost any Englishman would have refused to consider as a possibility.

"England has accomplished a wonderful organization of national unity and team work, entirely compatible with the individuality and initiative and enterprise which Englishmen and Americans will never give up. Railroads, mines, the controlled industries, shipping, and other big forms of enterprise are working under the local management of their owners—working under some satisfactory agreement as to remuneration. and with the individual managements in the direct employ of the nation, exercising all their abilities to do what the government directs. Outside of these, enterprises that are still under independent management, and looking for profits in the ordinary way, are nevertheless guiding their activities in accordance with definite government policies, subject to its permission in regard to materials, labor, prices, wages and priority of preference in handling business.

"War-control has practically gripped every person's affairs. Wastefulness at home or in the shop is an offense. The government has power to assume control whenever it sees fit, of any factory, any railroad, any farm, any shop. It is a 'summary offense against the defense of the realm' for either workman or business executive to absent himself from any work or duty in which the government has an interest, to wilfully miscarry instructions, or to impede or delay the production."

"We have," the article continues, "a Council for Industrial Defense, with a Priority Board, at Washington. We are already throwing the full strength of our great metals industries into war preparations. Our railroads have been coördinated. If the Government decides to adopt the English idea of automatic priority control of business, giving a convenient period for preparation, our great industrial resources should assume the expected burden."

Ford's Tractor "Food Makers"

In a description of the new Ford tractor Theodore M. Knappen, writing in the New York *Tribune*, says in part:

If the last crust will win the war, as the German food dictator says, the crust will be ours. Fifty mechanical horses working a 7000-acre farm near Detroit are showing the way. These 50 little farm tractors are the officers in training for the million that are to come. They are showing how they can do everything on a farm that a horse can do—and a lot more. The horses can go to war. The little tractors will look after the farms and the food supply.

If the war lasts another year, 50,000 of these little tractors will replace 600,000 horses and an untold amount of human labor. If it lasts five years a million tractors will be doing the work of 6,000,000 horses and a million men. After that we may expect to see a mil-

lion mechanical horses born yearly—born full grown and ready to work.

The first battle will be fought in England. The first tractor army goes there—paid for by the British government, but without profit. Thus the tractor baffles the submarines. Food produced in England is never sunk.

It's a little machine, this tractor. It is only eight feet long and four feet high. Husky farmers look at it and joke about buying one for a watch charm. But the Ford organization brains, experience and money are behind it. Several hundred men are at work in the experimental factory located on the farm. Actual production on an enormous scale is near. The difficulties in the way—such as lack of material—are great, but as a war measure the tractor has the right of way.

And after the war? A revolution in agriculture. These little machines will eventually cost as little, perhaps, as $200 or $300—not more than a good draft horse, and it costs less to keep them up.

The day before I had seen 40,000 men at work in one Ford factory. I foresaw another army corps turning out a "food maker" a minute—and winning the war.

"Yes, that little contraption," said a motor manufacturer, "which a child can handle, ends the farm-labor problem and will make the crops while the boys in the trenches fight for democracy. American mechanical genius will put a hundred thousand airplanes on the fighting line and a million food producers on the last reserve line—the bread line—come the end of the war by battle shock or rations, we win."

War Will Take All Steel

It should be anticipated that the steel situation which is developing with rapidity, says a bulletin issued by the United States Chamber of Commerce, will probably make it impossible for general manufacturers who are unable to find a steel substitute, to secure adequate supplies of steel and may even make it impossible to secure any. No substantial increase in production is anticipated. Even maximum production from existing facilities cannot be expected, because transportation, labor, and material conditions will interfere with the full operation of plants. On the other hand, indications are that the war requirements will continue to increase.

Steel is needed in war for ships, railroad cars and locomotives, rails, trucks and containers. It must be had for shells and other munitions work. In addition, businesses producing Government supplies, and the necessities of life require steel in great quantities. When all these requirements are met, it is said, little if any steel will be left for so-called general business.

Materials which can be used in place of steel are plentiful in comparison. Lumber may be expected to meet all needs, and cement may be had in quantity for concrete work. While there may be delays in getting supplies of these materials, a hopeless shortage does not exist. The course for business men is clear. Every effort should be made to use wood and concrete in place of steel, and work requiring steel should be postponed wherever possible.

Apparently little will be gained by contracting ahead for steel. Experience today indicates that it will soon be necessary for producers of steel to ship their product where required in connection with the war rather than to fill such contracts as they may have on their order books. When the production of railroad cars and locomotives is interfered with because necessary steel is going to industries producing pleasure automobiles, steel furniture and buildings for amusement purposes, the situation cannot be expected to continue.

Business men will probably make their plans in the expectation that soon there will be established an order of distribution of steel, and that the wild scramble to enter orders for future delivery of steel will be ineffective. In fact, failure to recognize this may lead to unfortunate results. In a business requiring steel, if contracts are placed for future delivery, not only for steel but for other materials, the manufacturer may find that he cannot get the steel but can get the other materials. In this case he might find that he had on hand large quantities of materials that he could not use because he had no steel.

In purchasing supplies, it is argued, business men will doubtless consider the wisdom of returning, as far as possible, to doing business locally. The extraordinary service being rendered by the railroads in connection with the war will limit general transportation and put an end during the war to the condition that has developed during the last 50 years. No longer can a man in Illinois rely on Pennsylvania as a dependable source of supply for raw materials and equipment. For many commodities the railroads can no longer spare the equipment to bring distant points into close contact. Purchase must be made near at home wherever this can be done. The preference that must be given to shipments of iron and steel will soon make this situation of daily importance.

Conference on Steel

The details of the conferences between the steel men and the Government authorities relative to the Government's steel requirements are outlined as follows by the New York *Sun:*

1. The members of the committee on steel and steel products appointed by the American Iron and Steel Institute, representing from 65 to 80% of the finished-steel output of the country, agreed with the Government, owing to the urgency of supplying materials immediately, to accept the orders without knowing what prices they are to receive.

2. The Government contemplates placing a volume of business which in ship plates alone will call for more than 50% of the production by the steel manufacturers of the country.

3. The Government offered to pay the steel manufacturers 2½c. per lb. on account, the remainder to be according to the prices decided upon by the Federal Trade Commission, which is investigating the cost of actual production, and which are expected to be announced the second week in August.

4. The steel manufacturers refused this offer, declaring it was too low and would result in their being out of pocket.

5. Owing to the inability of the manufacturers and the Government authorities to reach an amicable agreement relative to what initial payment on account

should be, the steel manufacturers felt that rather than have any dispute as to a fair price to be paid on account they would accept the orders without any payment on account, being satisfied to wait until the Federal Trade Commission concluded its investigation.

6. The steel men who went to Washington informed the authorities that in making this arrangement they were speaking for themselves only and not for any manufacturers who were not directly represented on the committee.

7. The Government proposed that the steel manufacturers accept business for our allies at the same price at which they accept business from the United States Government.

8. The question whether the steel manufacturers will accept business from the allies at the same prices charged the United States Government will depend upon the fairness of the prices at which the Government's business is placed.

9. The manufacturers have accepted promptly what business already has been placed by the Government and are making the shipments as rapidly as possible.

10. The prices on business already accepted and in process of manufacture have been far below the figures of the open market at the time the orders were placed.

Traffic Cut Saves Coal

Fairfax Harrison, chairman of the Railroads War Board, in a recent statement says:

The railroads of the United States report the elimination of passenger trains aggregating 16,267,028 miles of train service a year. Every ton of coal, every locomotive, every mile of track space, every man whose duties are absorbed by an unnecessary passenger train can be put to effective use in freight service, and nothing is more necessary at the moment to insure the safety and prosperity of the country than that the railroads be able to handle the utmost possible amount of freight. The railroads gave in Apil some 15% more freight service, with practically the same facilities, than in the coresponding month last year.

The elimination of passenger service now reported will make available for other purposes over 1,120,000 tons of coal. Many railroads, especially west of the Alleghany Mountains, are still to be heard from.

The railroad systems in the Eastern department have cut out 8,598,696 miles of passenger-train service, thus saving 716,113 tons of coal a year. The Pennsylvania system eliminated 3,300,000 miles of train service, thus saving 186,876 tons of coal. The New York Central plans to save 126,000 tons of coal. The Erie has cut out 1,600,000 passenger-train miles, the Baltimore & Ohio 1,168,596, the Chesapeake & Ohio 850,000.

Roads in New England have arranged to eliminate 4,847,332 passenger-train miles, with a saving of 256,-724 tons of coal. The Boston & Maine cuts out 2,118,-948 miles of service, the New Haven 1,707,004 and the Maine Central 442,676.

The Pere Marquette and the Wabash, the only roads reporting as yet from the central district, have eliminated together 846,600 miles of service and plan to save 49,555 tons of coal. The Southern Ry. has cut out 1,900,000 passenger-train miles and will save 97,282 tons of coal.

Steel Ships of a New Type

A new type of steel cargo vessel, known as the Whittelsey-Panel type, is described in the New York *Sun* as possessing certain advantages in that it can be built more cheaply and quickly than the ordinary type of steel ship and faster, ton for ton, than a wooden ship. It is proposed to standardize the process so that the steel could be fabricated at plants in the interior, and assembled, like a motor car, at a coast shipyard.

The principle of standardization has run in and out of many plans for constructing cargo fleets at this time, but no other design, it is said, makes it possible to dispense with long ship rolls, necessary to bending the plates. These require something like 11 months to build, and cost about $50,000 apiece. The reason why no steel rolls will be required to bend plates for the vessel in question is that it will have, from stem to stern, but a single bent plate. Every plate can be turned out by an ordinary bridge plant, it is asserted, and, what is more important, can be shipped flat on railroad cars.

In the Whittelsey-Panel type every frame is a straight bar, every plate is flat, about 30 ft. long, forming a 3-ft. panel; every line, which is curved on other models, is drawn on an angle; the bilge panel, rounded on all other designs and requiring steel rolls for the plates, is diagonal and does away with the necessity for bilge keels.

This model, which was patented by H. N. Whittelsey, president of the Southern Shipbuilding Co., has been tested by Prof. Herbert C. Saddler, a scientific naval architect, in the test tank of the University of Michigan and proved to require no greater horsepower or no more coal than the best design of the ordinary form of ship.

Upon these lines it is proposed to construct cargo ships 375 ft. long, with a 52-ft. beam, 31.6 ft. depth, draft 24.6 ft. and with a capacity of 7500 tons. Both the plans and specifications have been approved by Theodore E. Ferris, naval architect of the Emergency Fleet Corporation, and by the American Bureau of Shipping.

Averaged Profits Not Excessive

Another economic consideration which some Washington proponents of price fixing are prone to disregard, says the *Engineering News-Record*, is the fact that the earnings of a given business are not constant in volume over a long period of years. Profits diminish to the vanishing point in many industries during a period of depression and are brought up to a fair average level by a higher margin when demand is good. Should any action taken now result in shearing some of the industries of the country of the extra margin of income which should serve to establish the surplus they will sorely need during the depression that is bound to follow, incalculable harm might be done to industry.

Of course, on the other hand, no one has any sympathy with a group of men who are determined to squeeze the last possible penny of profit out of a situation which might put the country at their mercy. However, while such undoubtedly exist, it is believed that they constitute a small minority.

Editorials

The Average Price of Copper in 1916

ALL the principal copper-producing companies now having published their reports for 1916, if they do so at all, it is possible to compare their average receipts for copper in that year, and also to make comparison with our quotational average, as we have done in each year through a long period. In publishing the corresponding review last year, we made the prefatory remark that "it should be noted at the outset that 1915 was a phenomenal period, and one in which conditions were extraordinarily confused." In 1916 conditions were even more phenomenal and more confused. This is perhaps the reason why the several copper companies refrained from giving so much data respecting the terms of their sales as they did in the previous year. Except in a few cases it is left to conjecture whether the figures that are given represent the net price, basis New York, received for copper delivered or for copper sold. In most cases, moreover, there is uncertainty as to whether the companies reported net price, basis New York, or gross price, the latter including freight and delivery charges up to the buyers' works. In general, the doubt on the latter point applies only to domestic business. In foreign business the producers in the main adopted in 1916 the practice of selling on the basis of cash, New York.

Figures for 1916 are summarized in the accompanying tables. The first gives the reported sales of electrolytic copper, the second of Lake copper, while the third gives comparative figures over the period of the last 12 years. Referring to the table of electrolytic sales, it appears that upward of 1,200,000,000 lb. of copper realized an average of 25.71c. per lb. This accounts for a very large proportion of the copper produced and sold in 1916. Indeed, we may say that it accounts for all of it, for it may be assumed reasonably that the Anaconda production of upward of 300,000,000 lb., together with the other unreported copper that is sold through its agency, probably realized about the same price as was got for the Inspiration copper, namely, 25.39c.; while unreported copper sold through the American Smelting and Refining Co. undoubtedly realized about the same as was got for the copper of the Hayden, Stone & Jackling companies; taking account, moreover, of the large amount of copper that is sold to consumers on the quotational average, we may assume that the entire production—about 2,300,000,000 lb.—of American refiners in 1916 was sold at an average of about 25.71c. That figure is, if anything, too high, for without any doubt it includes in many cases prices that were gross; that is, including amounts that producers had to pay out for freight in delivering to their customers or allowances that they had to make for bills discounted.

Reports of the Michgan companies show the sale of 257,000,000 lb. of copper at an average of 25.02c. per lb. Their reports represent practically all the Michigan production.

The average realized for all the copper sold in 1916 was far below the quotational average. This is explained by the fact that in 1916 the conditions were, in general, those of a rising market. Copper was sold by the producers in large blocks, after which the market, continuing to rise, was made on relatively small transactions. The difference between the sales average and the quotational average in 1916 is, therefore, the difference between a quantitative and an arithmetical average.

The same condition is reflected in the wide range of price received by the several companies. These averages ranged from 23.18c. in the case of Shattuck Arizona to 27.35c. in the case of United Verde. The low prices were due to the early sale of large quantities of copper at times when the market was relatively low. The highest prices were realized by those companies that did not adopt the policy of selling all their output ahead, but reserved all or a considerable proportion of it and followed the market upward. The concerns that did that realized approximately the quotational average.

Two noteworthy features of these figures are the realization of a lower average for Lake copper than for electrolytic and the relatively slight variation among the prices received by the Lake producers.

COPPER SALES IN 1916 BY ELECTROLYTIC PRODUCERS

Company	Pounds	Proceeds	Av. Price
Braden	42,153,270	$12,648,111	26.350c.(e)
Calumet & Arizona	74,898,788	18,498,503	24.698 (d)
Chino	72,319,508	19,139,269	26.465 (b)
Inspiration	120,772,637	30,667,796	25.393 (e)
Miami	53,433,863	13,072,440	24.465 (e)
Kennecott	108,372,783	28,042,396	25.340 (e)
Nevada Consolidated	90,735,287	23,436,637	25.830 (a)
North Butte	21,505,584	5,009,726	23.295 (f)
Phelps, Dodge & Co.	247,303,587	60,539,918	24.480 (d)
Old Dominion	17,654,643	4,734,276	26.810 (b)
Ray Consolidated	74,983,540	20,038,448	26.724 (b)
Shattuck Arizona	18,161,763	4,209,897	23.18 (g)
U. S. Sm., Ref. & Min.	28,888,093	7,886,583	27.297 (b)
United Verde	58,299,573	15,946,145	27.352 (c)
Utah Copper	187,531,824	49,019,308	26.139 (b)
Total	1,217,014,743	$312,889,453	25.710
E. & M. J. Average	.....	.....	27.202

(a) F. o. b., Atlantic Seaboard. (b) Probably price delivered; not stated in report. (c) Price delivered. (d) Sold and delivered in 1916; net price f. o. b., New York. (e) Net price. (f) Probably, gross price. (g) Average for copper delivered.

COPPER SALES IN 1916 BY LAKE COMPANIES

Company	Pounds	Proceeds	Av. Price
Ahmeek Mining Co.	24,142,158	$6,210,245	25.72c.
Allouez Mining Co.	10,219,290	2,586,011	25.30
Baltic Mining Co.	12,425,804	3,141,243	25.28
Calumet & Hecla Min. Co.	76,762,240	19,559,019	25.48
Centennial Copper Min. Co.	2,367,400	592,269	25.02
Champion Copper Co.	33,601,136	8,494,367	25.28
Franklin Mining Co.	3,116,566	792,623	25.43
Isle Royale Copper Co.	12,412,111	3,209,537	25.86
LaSalle Copper Co.	1,380,352	354,409	25.68
Mass Cons. Mining Co.	4,752,588	1,248,780	26.27
Mohawk Mining Co.	18,468,100	3,496,860	25.28
Osceola Cons. Min. Co.	19,586,501	5,040,013	25.73
Quincy Mining Co.	21,065,612	5,374,715	25.50
Superior Copper Co.	3,034,656	748,732	24.67
Trimountain Mining Co.	8,720,558	2,204,557	25.28
Victoria Copper Min. Co.	1,127,193	293,297	26.02
White Pine Copper Co.	4,207,449	1,062,802	25.26
Total	257,389,714	$64,409,479	25.024

PRODUCTION, SALE AND PRICE FOR COPPER FOR 12 YEARS (a)

Year	Total Production	Pounds Reported	Average Realized	Quotational Average
1905	219,000,000	82,372,955	15.597 c.	15.699 c.
1906	224,071,000	113,411,645	19.146	19.616
1907	220,317,041	66,316,025	18.043	20.661
1908	222,267,444	125,949,248	13.348	13.424
1909	226,602,134	136,005,773	13.221	13.335
1910	221,400,864	126,710,763	12.96	13.039
1911	216,412,867	135,329,098	12.657	12.634
1912	1,228,333,298	552,155,308	15.841	16.341
1913	1,406,448,665	658,533,402	15.222	15.269
1914	1,342,634,206	566,687,750	13.458	13.602(b)
1915	1,411,652,418	619,832,987	17.299	17.275
1916	2,300,000,000	1,217,014,743	25.710	27.202

(a) Up to 1912 the figures represent Lake copper production and sales, but few of the producers of electrolytic making detailed reports in that time. Beginning with 1912, the figures represent electrolytic copper only. The figures for "pounds reported" and "average realized" do not include the United Metals Selling Co. (Anaconda), which does not publish these details. However, it is a reasonable assumption that its results were not very different from those of the other companies, for John D. Ryan has stated that in the 10 years ending with 1913 his companies sold 5,560,000,000 lb. of copper at an average of 14.82c., delivered to the buyers in Europe and America. This would be equivalent to 14.62@14.67 c., net cash, New York. During the same 10-year period, Phelps, Dodge & Co. reported an average of 14.56c. per lb., net cash, New York, actually realized. The arithmetical mean of the quotational averages for electrolytic copper in this period is 15.06c.

(b) Average for nine months. No quotations in August, September and October. However, the bulk of the copper sold in 1914 was disposed of before and after those months, wherefore the comparison on the nine months' basis is approximately correct.

Are We Losing at the Bunghole?

WHILE Daniels and Baker and Denman are fussing about prices and cheese-paring of contracts; while Denman and Goethals are squabbling; while members of the cabinet and of the several bureaus repudiate the acts of each other, exhibiting complete absence of team work; while all these things are happening, does it occur to any responsible heads in Washington that we may be losing at the bunghole while saving at the spigot? What is the use of saving one million dollars, if, by delay over the matter, the war be prolonged one single day? It is estimated that Mr. Denman's performances have set us back to the extent of 250,000 tons in the shipbuilding program, that is, there will be just so much delay in obtaining the necessary tonnage. It is possible, although not probable, that just that thing might spell loss of the war. Mr. Denman ought to be fired summarily.

(Since the above was written, the news has come that Mr. Denman has been fired. We are sorry that at the same time the country has had to lose the services of General Goethals. However, it is a blessing that Denman is going. Would that there were more to go).

The historic failing of our President in his appointments of incompetent men is now coming home to roost, and unfortunately is doing so when our country is in a crisis. There are constant appeals in controversies to the President. He is the only arbiter that is recognized, and consequently he is overworked. No administrator can attend to the multiplicity of details that he is called upon to do. Alas! it is his own fault. The constantly recurring "appeals to Cæsar" are due to the knowledge of the incompetence of many of the men who surround him. If they were of a different caliber, if they were men whose judgment were recognized, there would be no need of going to the commander-in-chief.

The long and short of the matter is that we have entered this great war without any adequate organization and have tried to fashion something on the spur of the moment. The makeshift machine has not worked well, and we shall have a lot more of muddling, as we have had already, until the functioning parts are improved. Other countries had to go through the same thing. We are hopeful that our course of development will not need to be so long as it was in Great Britain. It is a pity, though, that affairs in this country, and especially business, should be under such a cloud of pessimism, three months after the declaration of war, when a few clear and decisive words from Washington would clear up everything. We do not imagine that the administration has any real idea of fighting this war with the people in gloom over business prospects.

Situation in the Copper Market

DURING the period of uncertainty over what the policy of Washington is going to be, the inquiries of domestic manufacturers have been few and far between, and some interests in copper being desirous of selling, the market has been weak. Why should any manufacturer want to buy when he has been given to understand by Washington that the price for copper is going to be "reasonable" and is going to be the same to everybody? Of course, there is doubt as to what Washington means by "reasonable." It is possible that 27 or 28c. per lb. will be pronounced reasonable. However, the idea has been promoted that the price for copper is going to be lower than now, and therefore the manufacturer naturally stays out of the market.

If the price for copper is be lower, it will be, we think, owing to natural conditions and not to any ukase by Washington. Washington may commandeer copper and other things for the purposes of the Government, leaving the price to be determined by the courts, but Washington is not going to abrogate the law of supply and demand, no matter what theories on that subject may be entertained. Manufacturers and other consumers of copper might as well make up their minds to that. The price for copper is going to be determined by the quantity of it that the world requires. The price must be such as will produce that quantity. When unsold stocks begin to accumulate, the signal will be hoisted that the world is not needing so much copper as is being produced, and after a brief period of stabilization the market will commence to go off. It is the natural thing for any market to have the balance wheel of an unsold stock. No market is natural unless it be in that condition.

As yet, stocks of copper have not begun to accumulate. If there were signs of any such accumulation, they were but sporadic. The supply of crude copper was in excess of the refining capacity, and undoubtedly there were accumulations of crude copper. However, the check in production by the current labor troubles is rapidly reducing any such accumulation, if complete reduction has not already happened, and the time is in sight when the refiners will not have sufficient raw material. This is not a pleasant prospect either for domestic consumers or the American Government or our Allies.

At a time when all possible production of copper was badly needed, production has been checked. For this,

Washington is directly and unqualifiedly responsible. The talk emanating from quarters in Washington to the effect that the price for copper must be reduced was the direct inspiration for the labor troubles in Montana, Arizona and elsewhere. The miners in those regions have been paid according to a sliding scale based on the price for copper. If the Government were going to reduce the price for copper, there would be a reduction in wages. Therefore, the strikes. The men said that they would keep their wages on the basis of 30c. for copper, no matter what might happen to the price, and in view of the shortage of labor they had the whip hand.

Why should copper be singled out as a target for Washington to shoot at? The price for copper has not experienced the fantastic advances that have happened in other metals. The price for copper is high, to be sure, but considering the major market it has not been materially higher than the prices realized in 1906-07, which was a period of purely industrial boom, and the present price for copper is actually lower than then, although conditions of production are far more adverse.

Subscriptions to Belgian Kiddies, Ltd., up to date have reached a total of $98,965.69.

BY THE WAY

ALL YELPING AT HIS HEELS

The cartoon reproduced here was published by the New York *World*, July 18, 1917, by the courtesy of which paper we republish it. It is an essay in itself, and tells the whole story.

The largest ore carrier was launched on July 10 at the Sparrows Point yard near Baltimore. The vessel is owned by the Bethlehem Steel Co. and is to carry iron ore from Cuba to the United States. Her carrying capacity is 18,000 tons of iron ore, which is one-half more than the biggest carrier on Lake Superior can take. The size of the Lake boats is limited by the draft through the locks at the Sault Ste. Marie and over the Limekiln Crossing near Detroit. The ocean steamer is limited only by the depth of the harbor channel.

We have been hearing a lot about gages, how many are required for the proper measurement of guns, ammunition, etc., but it is doubtful if it is appreciated with what great accuracy they must be made. As an example gages are now being manufactured with fiber finger-grips so as to prevent expansion due to the heat of the hand. In a gage made of cast iron, the coefficient of expansion is 0.0000122 per degree C., or 0.00000542 F.

The Labor Situation at Butte

BUTTE CORRESPONDENCE

A telegram from Butte, Mont., under date of July 24, conveys the information that all mining companies of the Butte district have joined in a new scale of wages for miners, by which all classes of underground employees will, under present price of copper, receive $5.25 per day of eight hours. Minimum wage remains at $3.50 per day regardless of price of copper. Companies will also grant weekly payday to go into effect Sept. 1. By the new scale, when copper sells at 15 to 17c. per lb., rate of pay is $4 instead of $3.75 as now; from 17 to 19c. the wage will be $4.25; 19 to 21c., $4.50; 21 to 23c., $4.75; 23 to 25c., $5; 25 to 27c., $5.25; 27 to 29c., $5.50; 29 to 31c., $5.75; 31 to 33c., $6, and so on. All other classes of employees will get increase of 25c. on each 2c. increase in price of copper. Miners engaged in shaft work, winzes, station cutting and station tending will receive 50c. a day in addition to the scale for ordinary miners.

The new scale goes into effect July 25, but for men now at work it dates from July 1. Men reporting for work before July 30 will be taken on without formality of rustling card, but after that applicant will have to go through the usual course to get employment. The rustling-card system has been greatly modified, and some of its most objectionable features removed. It is believed that the concessions made by the companies will spell the end of the I. W. W. movement and strikes, although a majority of other crafts have voted against acceptance of the new wage scale offered by the mining companies. However, those crafts which are in a state organization are working in Anaconda and Great Falls to accept the proposition, which may force the minor Butte unions to abide by the result of the state vote, although Butte agitators threaten to withdraw from the state organization and go with the I. W. W. (which is hardly probable).

The I. W. W. people are apparently growing desperate and are making threats that they will attempt to picket the mines tomorrow to prevent men from going to work and committees have been waiting on boarding-house keepers to warn them not to put up lunches for men going to work. The mines today are working about 40% of their normal force.

Personals

O. B. Perry has a commission as captain in the Engineer Officers Reserve Corps.

F. LeRoi Thurmond will open an assay and engineering office at Anchorage, Alaska.

E. W. Westervelt has been appointed superintendent of the Hobson Silver-Lead Co., at Ymir, British Columbia.

J. F. Worley has been assigned as surgeon to mine-rescue car No. 1, at Reno; R. C. Williams, car No. 2, Raton; R. R. Sayers, car No. 5, Butte.

J. Morgan Clements is in Hokkaido, Japan, visiting the coal mine there. He recently visited the Kosaka mine, Japan's third largest copper mine.

Franklin W. Smith, of the firm of Smith & Ziesemer, mining engineers of Bisbee, is in Pittsburgh and expects to remain in the East until the middle of August.

Warren Lawson Kluttz, who has had an extensive experience in the operation of blast furnaces in the South, has been appointed general manager of the Sheffield Coal and Iron Co., Sheffield, Alabama.

Francis C. Shenehon, for the past eight years head of the College of Engineering of the University of Minnesota, has resigned and is now giving his exclusive attention to his practice as consulting engineer.

P. L. Williams has become superintendent at the works of the Empire Steel and Iron Co., Mt. Hope, N. J., succeeding H. M. Roche, who has become superintendent of the Wharton Steel Co., Dover.

J. E. Spurr, of Philadelphia, and ex-Governor Charles F. Millar, of Delaware, have returned from a visit to the mining region north of The Pass, Manitoba, where they are interested in the Otonopaw mine.

S. H. Chauvenet, formerly with the Robesonia and Sheridan furnaces in eastern Pennsylvania, will act as manager at the Island Park furnace, Easton, Penn., recently purchased by the Northern Ore Company.

R. Hirota and **K. Y. Shiga**, representing the Metallurgical Research Institute of Tokyo, recently visited Pittsburgh to study methods of electrical precipitation of smoke. Mr. Hirota is a lecturer on mining machinery at Tokyo University.

D. B. Dowling, of the Canadian Geological Survey, is pursuing his investigation of the coal resources of Alberta and Saskatchewan, and will exercise a general supervision of geological work in the oil, gas and coal fields of western Canada.

E. F. Burchard, of the United States Geological Survey, recently made a five weeks' trip during which he visited cement manufacturing districts in Pennsylvania, New York, Illinois, Kansas and Oklahoma and iron ore areas in Iowa, Missouri and Texas.

William Cockfield, of the Canadian Geological Survey, will take up the work of the late D. D. Cairnes in the Yukon territory, continuing an examination into auriferous gravels with special attention to areas in which tungsten-bearing minerals occur.

Forest Rutherford resigned his position on June 1, as general superintendent of reduction works of the Copper Queen Consolidated Mining Co., at Douglas, Ariz. He will go into business for himself as a consulting metallurgical engineer. His present address is c/o First National Bank, Pueblo, Colorado.

M. Cochrane Armour recently withdrew from the firm of Rogers, Brown & Co., of which he has been a partner for almost 27 years. He has had a prominent career as a producer and distributor of pig iron, especially in Chicago territory. He has been vice president and director of the Rogers, Brown Iron Mining Co., director of the Rogers, Brown Ore Co., Chicago Short Line Railway Co., and the Lake Superior Iron and Chemical Company.

Brig. Gen. William H. Bixby was recently elected president of the American Society for Testing Materials. He was born in Massachusetts in 1849 and was graduated from the United States military academy at the age of 24. During the long period of professional duty following, he was promoted to the rank of captain. In 1886 he was delegated to report on the stability of buildings injured by the Charleston earthquake, and shortly after took charge of the Cape Fear bridge. In 1897 he was given charge of the river and harbor improvements of the entire Ohio River from Pittsburgh to Cincinnati. From 1902 to 1904 he held a similar position on the St. Mary's River. He was made brigadier general and chief of engineers in 1910, retired from active service in 1913, and was again placed on the active list on May 21, 1917.

Obituary

N. L. C. Kachelmacher, chairman of the board of directors of Bessie Furnace Co., New Straitsville, Ohio, died at Philadelphia recently. He organized the Bessie Furnace Co., and was at one time president of the Hocking Coal and Iron Co., Columbus, Ohio. He was prominent in the effort to bring together several eastern companies about two years ago, including the Thomas Iron Co., Empire Steel and Iron Co., and Wharton Steel Company.

J. C. Kennedy, a retired veteran of the iron trade, died in Youngstown, Ohio, July 14. He was born Sept. 16, 1829, in the district in which he died. After the war he entered the iron business, and became prominent in the development of the industry in the Mahoning Valley. He operated the old Brier Hill furnace and furnaces in Struthers and Lowellville, all in the Mahoning Valley, and in the Pittsburgh and Buffalo districts. He was the uncle of Julian Kennedy, engineer, of Pittsburgh.

Societies

Association of Iron and Steel Electrical Engineers will hold its 11th annual convention at Philadelphia, Penn., Sept. 10 to 14. Wednesday, Sept. 12, is to be devoted entirely to a patriotic program, with addresses by army and navy engineers on vital subjects concerning industries. A. H. Swartz of the Westinghouse Electric and Manufacturing Co., Cleveland, is chairman of the entertainment and convention committee.

American Chemical Society will hold its annual meeting at Boston on Sept. 11, 12, 13, preceded by a meeting of the Council on Sept. 10. The Northeastern Section has been requested to omit the usual banquet and excursions and to arrange a simple and serious program bearing as fully as possible on questions concerning the activities of chemists in Government service and in the industries during the war.

Engineering Society of Northern Minnesota, composed of mining engineers of the Mesabi Range, held its annual outing on July 14, at Coleraine, the Coleraine members acting as hosts. The visitors were welcomed by a committee headed by William Curley and R. P. Weiderfeller of the Oliver Iron Mining Co.'s engineering staff. The Hill Annex and Arcturus mines at Marble were visited, also the Holman mine at Taconite, and the Canisteo and Walker pits, the trip finishing at the Trout Lake concentrator.

American Committee of Engineers in London is holding weekly meetings at which various plans and devices suggested by members for aid in the successful prosecution of the War are discussed. Recently a preliminary proposal was read for increasing the platinum output in the Ural field in Russia from 80,000 oz. to 150,000 oz. next year, by the use of the materials and equipment now on the properties but subject to government (Russian) control. It is recognized that under present private methods of production no increase is possible. The scheme implies the elimination of private interests with certain compensation both in producing and selling platinum, and the creation of a monopoly of it as a war measure by the Allied Governments.

American Association of Engineers unanimously elected the following officers during its annual convention on July 13: President, Edmund T. Perkins, president, Edmund T. Perkins Engineering Co., Chicago; first vice president, W. H. Finley, chief engineer Chicago & Northwestern Railroad; Second vice president, Isham Randolph, president, Isham Randolph & Co., Chicago. Directors for two years; Paul P. Stewart, Ketler-Elliott Erection Co., Chicago; R. C. Yeoman, dean of engineering, Valparaiso University, Valparaiso, Ind.; W. W. DeBerard, western editor, McGraw-Hill Publishing Co., Chicago; C. A. Soans, with Affield, Powell, Graver & Affield, Chicago; H. G. D. Nutting, consulting engineer, Armour Institute, Chicago; G. C. Dooge, designing engineer, American Bridge Co., Gary, Ind. Directors for one year; F. H. Newell, consulting engineer, University of Illinois, Urbana, Ill.; L. L. Sherman, president, L. K. Sherman Engineering Co., Chicago; H. W. Claussen, Engineering Bureau, City of Chicago: J. F. Gayton, president, Utilities Engineering Co., Chicago; A. D. Whipple, consulting engineer, Milwaukee, Wis.; A. P. Cunningham, engineering department, Illinois Central R.R., Chicago. Auditing committee; chairman, Samuel Morrell, Bridge Engineering Department, City of Chicago; G. A. Gaensien, Bridge Engineering Department, City of Chicago; J. T. Mullin, Wisconsin Steel Works, South Chicago, Ill. The proposed new constitution was adopted unanimously. Its main provision is the enlargement of the Board of Directors from 5 to 15 members, but the board may appoint five members to actively manage the affairs of the association. A clause to include associates is provided in the constitution. This membership pertains to men who are not necessarily engineers but interested in engineering affairs and may be admitted up to 10% of the certified membership.

Trade Catalogs

Elevating, Conveying, Crushing, Screening, Power Transmission Machinery. The Jeffrey Manufacturing Co., Columbus, Ohio. General Catalog No. 84. Pp. 352; 6 x 9 in.; illustrated.

Automatic Injector. The William Powell Co., Cincinnati, Ohio. Booklet. Pp. 12; 3½ x 6 in.; illustrated.

Duriron Pipe, Valves, Fittings, Centrifugal Pumps. Duriron Castings Co., Dayton, Ohio. Bulletin No. 100. Pp. 24; 8 x 10½ in.; illustrated.

Allen Concentrating Cone. Allen Cone Co., P. O. Box 299, El Paso, Texas. Bulletin No. 4. Pp. 32; 6 x 9 in.; illustrated.

Secondhand Equipment—Electrical, Steam, Hydraulic, Gas. MacGovern & Co., Inc., 114 Liberty St., New York. List of equipment on hand. Pp. 58; 3½ x 8½ in.; illustrated.

Electric Hoists. Lidgerwood Manufacturing Co., 96 Liberty St., New York. Bulletin No. 20. Pp. 32; 9 x 12 in.; illustrated.

"Stanley" Cotton Belting. Stanley Belting Corporation, 32-40 S. Clinton St., Chicago, Ill. Booklet. Pp. 8; 3½ x 6 in.; illustrated.

Emerson Steam Pumps, Quick-Cleaning Foot Valve and Strainer. The Emerson Pump and Valve Co., Alexandria, Va. Catalog. Pp. 56; 6 x 9 in.; illustrated.

Filtros—The New Porous Mineral Medium. General Filtration Co., Inc., Cutler Building, Rochester, N. Y. Booklet. Pp. 32; 6 x 9 in.; illustrated. This contains detailed information regarding the manufacture, composition, shapes, grades, uses and applications of this material.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Aluminum—Method of Treating Alunite. Frank K. Cameron, Washington, D. C. (U. S. No. 1,233,977; July 17, 1917.)

Aluminum—Process of Manufacture of Aluminum Nitrade. Ottokar Serpek, Paris, France, assignor to Société Generale des Nitrures, Paris, France. (U. S. Nos. 1,233,925; 1,233,926; July 17, 1917.)

Concentrator. James B. Freeman, Los Angeles, Calif. (U. S. No. 1,232,783; July 10, 1917.)

Cyanidation—Cyanide in the Form of Granules. Fritz Abegg, Perth Amboy, N. J., assignor to The Roessler & Hasslacher Chemical Co., New York, N. Y. (U. S. No. 1,232,471; July 10, 1917.)

Copper—Apparatus for Production of Copper by Electrolysis. Marcel Perreur-Lloyd, Boulogne-sur-Seine, France. (U. S. No. 1,233,906; July 17, 1917.)

Copper—Process of Extracting Copper from Oxidized Ores. Noak Victor Hybinette, Christiania, Norway. (U. S. No. 1,233,580; July 17, 1917.)

Electrolysis—Apparatus for Electrolytically Recovering Metals. George A. James, San Francisco, Calif., assignor, by mesne assignments, of one-half to James H. Alling and one-half to Francis M. Wright, San Francisco, Calif. (U. S. No. 1,233,363; July 17, 1917.)

Excavating Apparatus. Frederick E. Allen, Oakland, Calif., assignor to The International Excavator Company, Oakland, Calif. (U. S. No. 1,232,749; July 10, 1917.)

Magnetic Separator—Robert D. Pike, San Francisco, Calif. (U. S. No. 1,233,804; July 17, 1917.)

Smelting Process. Nils Testrup, London, England, and Thomas Rigby, Dumfries, Scotland, assignors to Wetcarbonizing Limited, London, England. (U. S. No. 1,233,144; July 10, 1917.)

Editorial Correspondence

SAN FRANCISCO—July 21

The Comstock is Exploring for the first time in 33 years, on the 2700-ft. level. The Union Consolidated is now the deepest working shaft in Nevada. On July 15 the 2700-ft. station was finished and the reopening of the 2700 level completed. On the following day exploration was started. The next deepest shaft on the Comstock is the C. & C. on the Con. Virginia, one mile south. The work of reopening the 2700 level was carried out from the so-called east vein, which is the east fork of the Comstock at the north end, or what is commonly termed the Virginia district. Although ample pumping capacity was installed on the 2700 level some time ago and the 2900 level is now drained, a large amount of work was required to reopen the old 2700 workings from the east vein back to the main Comstock. A large volume of hot water came from the workings near the Union shaft, which has now been caught up, and the east crosscut from the Union shaft is protected by "snowsheds" composed of bulking planks that keep the water from dropping down from the roof. of the drifts and crosscuts. These watersheds, which are locally termed "snowsheds," are provided on the 2200 and the 2300 levels. The work of exploration is now going forward on the main Comstock vein from the 2000 to the 2700 level of the Union and the same work has just been started on the Mexican. The old east winze in the Union will be reopened from the 2700 to the 2900 level. The water will be pumped from the 2900 by means of airlift and delivered to the main 2900-pumps of the Mexican-Ophir winze. Comstock exploration and development will now go forward in a way that will prove the policy of the present operators of the north end mines, under the superintendency of Whitman Symmes, to be in accord with the best practice in dealing with complex problems which require the handling of large volumes of water and reopening and exploring old mine workings. Every step made has been in the line of advancement since the present policy was adopted.

BUTTE—July 21

Labor Conditions have greatly improved in Butte during last week. An agreement has finally been reached between the mining companies and the Montana Power Co. on one side, and electrical workers and metal trades council on the other. The international unions and all organizations connected with the American Federation of Labor have concluded terms that are satisfactory to both employers and employees. These agreements were brought about largely through the efforts of W. H. Rodgers, the Federal mediator sent to Butte by Secretary Wilson of the Department of Labor. International President Frank McNulty of the Electrical Workers, as well as representatives from the head offices of the machinists, carpenters, engineers and other organizations were also instrumental in bringing about the agreements. The only union which has not concluded terms of peace is the Metal Mine Workers Union, with which the mining companies have refused to conduct negotiations. This organization is generally supposed to be affiliated with the Industrial Workers of the World, although its leaders deny this. It has issued a call for a convention of delegates from all the metal mine workers in America to be held in Denver, Colo., the first week in August. It has sent out invitations to the different miners' organizations to send delegates to this convention, and it openly announces its purpose of organizing a rival to the A. F. of L. and fighting that organization to a finish. Men who have been active in the I. W. W. in years past are among the leaders in this movement. This organization is still carrying on its strike. It has made an open attack upon the International Mine, Mill and Smelter Workers' Union, and the latter has come back by sending a large force of its organizers into the Butte field. During the past few days the Mine, Mill and Smeltermen have made tremendous gains in membership, and at the present time the two rival unions among the miners are of almost equal strength. The metal mine workers took a vote upon the question of affiliating with the A. F. of L., and going back into the Mine, Mill and Smeltermen's Union. This proposition was defeated by an overwhelming majority. The reason assigned for its defeat was that William Davidson, member of the executive board of the Mine, Mill and Smeltermen, announced that the Metal Mine Workers would have to join that organization as individuals, and that the first thing that would be done would be to order them all to go back to work and that later demands for a raise of wages and better working conditions would be taken up. At a meeting of the Metal Mine Workers last Friday federal mediator Rodgers went before them and urged them to return to work. He pledged them that if they would do so he would use his influence to secure a substantial raise in wages for them. His advice fell on deaf ears. Instead of paying heed to it, they adopted resolutions demanding his recall by Secretary Wilson. The electricians, machinists and other crafts returned to their old posts Tuesday morning. Several hundred miners who have been on strike went back to work at the same time. The mining companies report that at present they have about half of their normal force at work. Every day in the past week they have had an increase, and they look for a still larger addition to their force in the coming week. The companies it is understood are considering granting a raise in the miners' wage scale, which will have an immediate effect in restoring normal conditions throughout the district.

DENVER—July 21

The Leadville Strike is on, despite all efforts at mediation. The labors of Federal mediators—Verner Z. Reed and former Justice George W. Musser—resulted in reasonable concessions on part of miners who agreed to recall strike if wages were raised but 50c. per shift instead of the desired $1, and at same time to relinquish demand for recognition of the union. Samuel D. Nicholson, prominent mine operator, agreed to the miners' proposal, but his action was repudiated by the other operators who stand absolutely firm in their refusal to conduct any negotiations emanating from or presented by union officials. The opinion prevails generally that this is the crucial point in the controversy, owners preferring to close their properties down rather than yield, in the slightest degree, to the demands of organized labor. The request for a reasonable increase in wage would probably have been granted if such request had come from the unorganized miners instead of from the local union. The strike was in effect at midnight of July 20. The operators declare they will keep their properties closed indefinitely or until such time as the strikers offer to return to work upon prevailing wages. This determination presumably implies that plans have been arranged for preventing the flooding of the wet mines. On the other side, the union officers assert that the strike will be pushed relentlessly, although they have issued a warning to their members to conduct themselves as law-abiding citizens. Public sentiment, in this instance, is largely with the miners because it is conceded that $3.50 is not a sufficient wage, under prevailing conditions, to meet the necessities of life. Even $4 would not be a high wage when compared with the wages in other Western districts. Of course, anyone who was acquainted with the bloody struggle of some years ago that terminated the dominion of unionism in the district will appreciate the attitude of the operators who feel that to now yield the slighest attention to the local union would simply be offering an opening for future demands from the same or some similar source. Of the several thousands of mine and smeltery employees in the district, perhaps not more than 800 have any allegiance to the union. It is further pretty well established that the majority of the unionists are of the transient class. The strike will, therefore, work especial hardship upon the non-union miners who have been long-time residents of, and own their homes in, Leadville. Upless they now become members of the union, they will receive no share in the monetary benefits that are to be extended to the striking unionists; and this phase of the situation is unquestionably being relied upon by the officers of the union to secure an increased and stronger membership in the district. As a rule, the miners of Leadville are of the better class. The closing down of the mines and smelteries will probably result in the exodus of most of the undesirables. There is one thing of noteworthy significance in this affair, viz., that there is not the slightest suspicion of any I. W. W. influence. An analysis of the situation at present leads to the belief that the strike can be settled only by a concerted organization of the non-union laborers making overtures to the operators.

SALT LAKE CITY—July 21

Salt Lake Stock & Mining Exchange Clearing House will probably be established in the near future. The rules committee and the governing board of the exchange has issued a circular letter advocating the establishment of such an institution, providing mining companies whose stocks are listed on the exchange will publish a quarterly financial report for the benefit of the public and establish transfer offices in Salt Lake City, in order to facilitate the clearing of all trades made on the exchange.

Shipments from Coal Mines in Carbon and Emery County, cut off by flood on Price River, are being resumed. One track of the Denver & Rio Grande main line is in operation between Kyune and Castlegate. and the railroad within a day or two will be furnishing the mines with from 65 to 75% of cars needed. Mines on Pleasant Valley branch will be cut off somewhat longer, as damage there was especially great. The railroad will make use of lull in traffic to make repairs to locomotives, store cars, etc. There is said to be an adequate supply of rolling stock. The railroad is stated to be contemplating filing suit for $1,000,000 damages against the Price River Irrigation Co., the breaking of whose reservoir dam was the cause of the flood. The loss caused by the flood is equivalent to shutting down the coal mines for a month.

WALLACE, IDAHO—July 16

Annual Assessment Work suspension until the close of the war is decidedly in favor throughout the Cœur d'Alene district. This sentiment is based upon the difficulty in getting men to perform labor, high cost of labor and supplies, and heavy contributions the people have made and will make for the support of the Government through the purchase of bonds, payment of special war taxes and subscriptions to the Red Cross. For these reasons, and the further fact that assessment work is of slight importance so far as actual mining development is concerned and is required chiefly to show good faith of claim owners, the feeling here is opposed to substituting any other method of exacting the expenditure, such as depositing $100 for each claim in the land office to be used subsequently in development of the ground, or making an equal expenditure in production of something of value in prosecution of the war. The feeling here is that exemption from assessment work during the war should be absolute.

Pine Creek Railroad Agreement was formally closed between the Oregon-Washington Railroad and Navigation Co. and the mining companies of Pine Creek, which will result in the construction of branch railroad into that section without further delay. The branch will be 10 miles in length and the railroad company estimates the cost at $300,000. The mining companies are now paying from $3 to $4 per ton for hauling ore from the mines to the railroad, and as an inducement to get the railroad, the principal operators, a few months ago, offered to pay $1.50 per ton on all shipments over the proposed branch until the original cost of construction has been covered. Following the report of Albert Burch on the actual and prospective ore tonnage in sight, the railroad company last week notified the mining companies that the construction of the railroad had been favorably considered and that the company was prepared to begin construction at once, the surveys having been completed last year. As a condition, however, the mining companies were asked to enter into an agreement to pay $1.50 per ton on the first 100,000 tons of ore shipped and $1 per ton on the second 100,000 tons, the rate thereafter to be established by the state utilities commis-

sion. Representatives of the mining companies and a representative of the railroad company immediately met at Kellogg and entered into the agreement. Contractors are preparing to begin work at once and the road will be completed before bad weather this fall. With the railroad assured, Pine Creek is certain to advance rapidly to a position of importance as a producer of both lead and zinc.

JOPLIN, MO.—July 21

Black Diamond Core Drilling being tried at Ramage mine at Century, and reported as successful. Machine is of the Sullivan type and first hole now down to depth of about 150 ft. Core drilling has been tried only once or twice previously in this field, and scarcity of drill rigs has brought about this tryout.

Dry Concentration for chunk zinc blende being tried out successfully by Montreal Mining Co. at Century, Okla. When mine was originally opened several carloads of chunk blende were shipped to the smelteries, but chunks were too large to handle without crushing and smelteries were not equipped to do this. Consequently ore did not receive top price. Recently the Montreal company encountered more of the chunk formation and is keeping it separate from remainder of ore and crushing it dry to save losses that occur where almost pure ore is sent through wet concentration process.

Largest Mining Deal in history of the district, with the exception of purchase of Granby holdings by American Zinc, was consummated last week, when L. C. Church and associates, of Joplin, sold part of their holdings known as Welsh properties, to L. S. Skelton and associates, of Okmulgee, Okla., for consideration of $2,000,000. The Welsh holdings consist of three mills in operation with fourth nearly completed, and several hundred acres of land near Century, Okla. The land was first developed by L. C. Church of Joplin and E. C. Mabon, of Miami, about two and one-half years ago. Mabon sold his interests for $85 about eight months ago, but Church, who was the original promoter and one of the pioneers in the north Oklahoma field, has steadfastly refused to sell any but comparatively small sub-leases up until this deal. The Welsh mines now have come to rival in production those of the Eagle-Picher Lead Co., and the three mills are making close to 500 tons of concentrate weekly. L. S. Skelton, purchaser, has large interests in coal and oil. He purchased the Tar Creek mine at Tar River, Okla., early in the spring, and later the Wyrick. F. J. Childress, of Galena, Kan., has been made manager of the five concentrating plants for the present.

SPOKANE, WASH.—July 20

Magnesite Mining is a new industry that has sprung up in the State of Washington as a result of the restriction of imports, consequent upon the war. At Valley, in Stevens County, the American Mineral Production Co. is mining several hundred tons per day and is installing calcining equipment to treat 9000 tons monthly. This is a crystalline magnesite said to equal the Austrian in purity. Some of the quarries can produce material containing less than 1% CaO and 2% SiO_2 and the company can regularly guarantee shipments containing less than 3% of these impurities. The deposits are extensive and present production is only limited by inadequate railroad facilities. The United States Magnesite Co., organized by C. P. Oudin, president of the American Fire Brick Co., of Spokane, has been developing quarries about 17 miles west of Springdale and three miles from the logging railroad of the Phoenix Lumber Co. Two calcining furnaces are contemplated and some material already calcined in a test ran 86.66% MgO and not over 3% of any impurity. The manufacture of magnesite bricks is to be undertaken in Spokane at the old brick plant of the Clay Products Co., lately bought by C. B. Stowe & Co., of Cleveland, Ohio, and leased to the American Fire Brick Co. Near Chewelah, Wash., the Northwest Magnesite Co. has bought 20 acres for a calcining and manufacturing plant. The quarries, five miles distant, are being worked day and night for an output of about 300 tons daily and an aërial tramway is to be installed to deliver the crude material to the calcining plant, which will contain two 7½x125-ft. furnaces with the necessary crushers, screens and rolls. Grain magnesite is to be produced for Eastern steel furnaces and powdered magnesite for the plastic trade. The company was recently incorporated for $1,000,000 and is adequately financed, its officers including men of prominence on the Pacific Coast as follows: President, R. S. Talbot; vice-president, F. B. Morse, manager of the Pacific Improvement Co.; consulting engineer, B. L. Thane, manager of Alaska Gastineau Mining Co.; secretary, Seabury Merritt; treasurer, D. J. Murphy, assistant cashier of Crocker National Bank of San Francisco; manager, R. D. Adams. William H. Crocker, of San Francisco, is also stated to be interested in this enterprise.

TORONTO—July 21

Increase in Wages of the Cobalt miners by the additional bonus of 25c. per day, following the increase in the price of silver to upwards of 80c. per oz., has dissipated any lingering apprehension of further serious labor troubles. At a special meeting of miners held on July 15, a resolution was adopted declaring that the men are as a whole satisfied with the pay at present received, and recommending that the strike vote of June 24, be not put into effect "until changed conditions necessitate such action."

Lignite in Saskatchewan may be utilized. According to a statement made by Prof. Ruttan, of the Canadian Advisory Council of Scientific and Industrial Research, to the Canadian Manufacturers' Association at their annual convention, held in Winnipeg, this week, the coal difficulty can be solved for the western provinces of Canada by utilizing for fuel the extensive lignite deposits of Saskatchewan. He claims that a process has been discovered, through the researches of the council, by which the lignite can be converted into briquette form at a cost of about two-thirds the price of anthracite in that market, and that the briquettes are equal in heating power to the imported coal. The research council has advised the government of Canada to establish a plant in Saskatchewan at a cost of $400,000 to carry out the process.

The Mining News

ALASKA

LABOR SITUATION at Kennecott, according to recent reports, developed nothing new, quiet and order prevailing among miners. Some I. W. W. agitators and few pro-Germans present, but unable to influence miners.

ALASKA COPPER CORPORATION (Stretna)—Being developed by Philadelphia men. Has taken in auto trucks to haul ore to railroad in the autumn. Mill to be erected. H. W. Du Bois, of Philadelphia, consulting engineer.

MOTHER LODE COPPER (McCarthy)—Installing here 500-kw. electric plant to supply power to mine. Contemplate concentrator this year. During winter shipped 37 carloads of ore, averaging about 30% copper. Mine about 16 miles from Copper River & Northwestern Ry.

IN COPPER RIVER REGION, George C. Baldwin has optioned the Big Four group of J. J. Miller and Oscar Hanson, on the Chitystone, about 20 miles from the inland terminus of Copper River Ry. P. J. Bonner is developing group of claims near the Lakinaw. Placers on Dan and Chittibu creeks are being worked day and night. In Bering River coal field, Clark Davis is developing 160 acres, after years of litigation, and expects to bring coal to Controller Bay, next autumn.

ARIZONA

Cochise County

LABOR SITUATION in Douglas shows smelteries running at capacity with full supply of ore.

Gila County

STRIKE SITUATION in Globe shows no improvement, all miners still out. Mechanics and electricians have gone back. Pumps running.

Mohave County

CROW CANYON SECTION of Cedar Valley mining district, a vein of wulfenite, 18 in. wide recently been opened up by O. T. Flynn and Martin Hamilton.

EMPIRE ARIZONA (Parker)—Eagle's Nest shaft recently reached 240-ft. mark to be continued to depth of 1000 ft. Other development stopped while sinking is in progress.

DIAMOND JO (Kingman)—Vein which has never been found below lower tunnel picked up at the south end of property. New tunnel to be driven to tap vein at greater depth.

SCHUYLKILL MINING CO. (Chloride)—Confining operations to providing additional boiler capacity and lowering pumps to 800 level. Nearly ready to begin drifting on 800. T. J. Torpey, superintendent.

CHLORIDE & TELLURIDE (Chloride)—Fire destroyed shaft house, necessitating sending east for machinery parts. Taking out ore from 175 level when accident occurred. H. L. Heath, superintendent.

PAYROLL MINE (Chloride)—Leased to L. F. Martin of Chloride. Delivered 50 tons ore from 200 level to Steffy custom mill. Principally zinc content. Raising from 400 to 200 and drifting south on 400. A. W. Henning, superintendent.

Pinal County

GILA DEVELOPMENT (Kelvin)—Pump installed in shaft and sinking resumed.

PINAL DEVELOPMENT (Kelvin)—Raise started from main funnel to cut ore recently discovered in winze. Raise will be driven 125 ft.

TROY ARIZONA (Kelvin)—New Climax shaft nearly reached 300 ft. level. Good shipping ore being opened in work tributary to Rattler shaft.

Yavapai County

DEL MONTE (Wenden)—Formerly owned by Ridgley estate purchased by Gov. Meikeljohn, D. Wiggers and associates.

CRITIC (Wenden)—Recent shipment of over a car load of ore to Humbolt showed high copper-gold contents.

ARKANSAS & ARIZONA (Jerome)—Water power temporarily shut off by electrical storm. Mine flooded on 1640-ft. level for several days. Drilling stopped. Expect to continue drilling flat hole from face of east crosscut.

HULL COPPER CO. (Jerome)—Will attempt to secure redistribution of stock by stockholders' suit for injunction and judgment against S. F. Denison, administrator of late G. H. Hull estate. C. W. Clark also sued as trustee is general manager of United Verde Copper Co. and son of ex-Senator W. A. Clark, owner of United Verde. Intimated that Clark interests are close to having possession of Hull Copper Co.

CALIFORNIA

Amador County

KENNEDY (Jackson)—G. Shoni was killed on July 13, while barring down rock in the 2400-ft. level. Details of the accident not at present available.

SIMONDS & LATHAM (Jackson)—T. Miller, working in tailing cyanide plant on Argonaut mine, caught in belt and thrown against timbers, being seriously injured before fellow workman could shut off electric power. Few months ago W. Bell, an engineer, met with similar accident at this plant and was instantly killed.

Calaveras County

COLUMBIA (Angels Camp)—Owner, John Ferraris, will reopen under organization of new company. Formerly productive, but requires new development.

LUCAS (Mokelumne Hill)—High-grade ore developed in small stringers, averages 6 ft. wide High-grade is black and white quartz with free gold. Being developed by Robert Irvine.

Eldorado County

WATER USERS ASSOCIATION (Placerville)—Filed with State Railroad Commission petition that Western States Gas and Electric Co., who recently acquired properties of Placerville Gold Mining Co., that water be furnished for irrigation and that the company be prohibited from using

water for hydro-electric plant. The 235 members in the association will demand irrigation water whether mines and other users of electric power be supplied or not.

BALD MOUNTAIN (Placerville)—High-grade chrome ore being shipped to railroad by animal teams; 250 tons already shipped and large amount to be extracted. Six-animal teams haul 2½ tons per load.

Inyo County

MINARETS (Mammoth)—Drilling equipment arrived at Bishop and will be shipped and installed immediately. Mr. Eddy is manager and principal owner.

CERRO GORDO (Keeler)—Suit of Susie C. Simons for damage for use of waters of Crohn springs, part of the Cerro Gordo holdings disputed by the plaintiff, resulted in verdict awarding her $4000. Suit was for $9000. Case will probably be appealed.

Kern County

TUNGSTEN being produced from old dumps of Consolidated mine in Randsburg. Ore came from 60-ft. level and not considered of sufficient gold contents to pay for milling. The 3-ft. vein from which ore was taken was mined and milled until it was no longer pay ore at time when demand for tungsten did not encourage much effort on the part of leasers and prospectors.

Mariposa County

SWEETWATER (Merced) — Property owned by Taft oil men, being operated by small force of men. Equipped with mill.

EARLY (Jerseydale)—Resumed operation with 30 men, after 18 months litigation. New mill contemplated. George M. Hook, superintendent.

Modoc County

VALLEY VIEW MINING CO. (Alturas)—Property at Copper Peak said to contain high-grade copper ore carrying gold, averages about 5 ft. wide. New adit level will be started to connect with shaft and cut orebody at 1200 ft. Reported ore also contains nickel.

Mono County

BENTON TOWNSITE title being contested by United States in hearing before land office. Particular land in contention contains 120 acres was located in 1907 and came into possession of State of California and transferred to L. S. Brown. In 1913 Government started proceedings to recover title on ground that land was occupied by Indians and more than 40 acres was mineral land. If Government wins town of Benton will be without a legal site, but it is probable that occupancy will not be denied owners of homes.

Nevada County

ALLISON RANCH (Grass Valley)—New mill ready for operation. Test run satisfactory. Equipment consists of 40 stamps and concentration tables. Mill bins full of ore and extraction progressing.

PITTSBURGH (Nevada City) — High-grade ore encountered in crosscut. Ore is refractory and will have to be treated by other than milling method. Superintendent Oates believes recent disclosure is lead to main orebody.

DELHI (Columbia Hill)—Leased to A. A. Codd of Reno, Nev., and eastern associates. Exploration and development will be carried on with view of large production. Mine has produced about $3,000,000. Hamilton Eddy, superintendent.

San Bernardino County

TWO HIGH-GRADERS sent to jail for 120 days recently for stealing tungsten ore from Atolia mill. High-grading has not been general in tungsten camp for year or more.

Shasta County

NOBLE ELECTRIC STEEL CO. (San Francisco)—W. H. French of Judson Manufacturing Co. of Oakland, elected vice-president and general manager. H. H. Noble, who developed electric plant at Heroult, Shasta County, retires from active management, but retains stock in company. W. W. Clark remains superintendent of operating plant. Heroult smeltery manufactures ferromanganese by electrolytic process and is said to have passed experimental stage and manufacturing a commercial product.

COLORADO

Gilpin County

EUREKA (Central City)—New machinery for mill received. Shaft sinking under way.

GOLD CUP (Central City)—Good-grade oreshoots opened on 85- and 165-ft. levels; shipments being made. Shaft, now 216 ft. deep, will be sunk 200 ft. and crosscut driven to Keystone vein.

PEARCE (Central City)—Mine in Lake district opened second vein in crosscutting on 300-ft. level. Drifting to junction now under way.

HOMER (Central City)—Jackson lease taken over by M. T. Chestnut and A. Clark. Shaft 200 ft. deep will be sunk 200 ft. more. Mine has produced good-grade gold-copper ore.

GOLD CUP (Central City)—Electrically operated air compressor, hoist, and machine drills will be installed. Colorado Power Co.'s line extended from Grand Army mine. Shaft will be sunk to 500-ft. level. One opened on 165-ft. level shows 2- to 12-in. shoot shipping-grade ore in 6-ft. shoot of milling-grade ore.

Hinsdale County

BUCKEYE (Lake City)—Gold-silver ore opened by lessee W. E. Mendenhall. Size of oreshoot not yet disclosed by development work. Discovery caused rush of prospectors to district.

Saguache County

SHAWMUT (Bonanza) — Satisfactory progress being made in driving lower tunnel to cut bottom of old shaft workings; tunnel to serve for drainage and transportation. Electrical power being installed.

RAWLEY (Bonanza)—Raise from 1200-ft. to 600-ft. level holed through; will make economic working of ore on upper levels. Tramway construction delayed by non-delivery of supplies; survey completed. Tramway will be over 6 miles in length. Regular shipments of heavy pyrite ore, carrying copper, gold and silver being made from 1200-ft. level.

San Juan County

SHIPMENTS FROM SILVERTON during the month of June were as follows: To outside smelters from the Sunnyside, 34 cars; Iowa-Tiger, 18; Gold King, 15; Pride of the West, 9; Silver Lake Custom Mill and S. D. & G. Leasing Co., 6 each; Highland Mary, 5; Silver Ledge and Mayflower, 4 each; Dives Leasing Co., 3; St. Paul, Hamlet and Anti-Periodic, one car each; miscellaneous small shipments, 9 cars; total, 116 cars. The following shipments were made to the Silver Lake Custom Mill for concentration, from Champion, 6 cars; Lackawanna, 2; Allen & Fattor, 2; Frank Waller, one; total, 11 cars. The North Star Custom Mill received 11 cars from the Detroit-Colorado property.

SUNNYSIDE (Eureka) — Contract for building new 4-mile aerial tramway from mine to new milling plant let to Harry Doyle, of Telluride.

GREEN MOUNTAIN (Silverton)—Being operated under lease by American Smelting and Refining Co.; ore shipped to Silver Lake mill.

LACKAWANNA (Silverton) — Compressor plant and electric power to be installed and tram built from mine to mill. Mill will be finished by autumn.

PRIDE OF THE WEST (Silverton)—Six cars concentrate shipped during June. When tramway to Green Mountain mine is completed, mill will be operated three shifts instead of one as at present. A. W. Harrison, manager.

San Miguel County

CARRUTHERS (Telluride)—Active operation of Inama & Perino Leasing Co., keeping 60-ton mill working at full capacity.

Summit County

EXCELSIOR PLACER (Breckenridge)—Tunnel being driven to open vein of lead ore on lode claims.

PIONEER CONSOLIDATED (Breckenridge)—Twenty-stamp mill now running full capacity.

LEE MINING CO. (Breckenridge)—Shaft sinking resumed. Shaft house burned several weeks ago.

LENAWEE (Breckenridge) — Mine will be reopened; tunnel now in 600 ft. to be driven 200 ft. further. Mill will be remodeled.

WELLINGTON (Breckenridge)—Recent development work opened on lower levels, ore assaying higher than former average grade.

ORO EXTENSION (Breckenridge)—Leasing company has completed unwatering shaft; catching up caved ground preparatory to development. Pumps handling 400 gal. per min.

EXCELSIOR (Breckenridge) — Mine workings being reopened and mill being remodeled. Fine-grinding machinery and flotation plant to be installed. Has own electrical power plant.

Teller County

CRESSON (Cripple Creek)—Oreshoot recently opened on 14 level showing up better. Drift on 16 level will not reach oreshoot until October.

IDAHO

Custer County

EMPIRE COPPER CO. (Mackay)—Contract for 16,300-ft. aerial tramway given to American Steel & Wire Co. Will begin laying foundations for towers shortly. Developing large mineral resources in oxidized zone suitable for steam-shovel operations in future.

Shoshone County

YUKON GOLD COMPANY (Murray)—Dredge shipped from Alaska being reconstructed on Prichard creek about a mile below Murray. Barge about ready to launch and expect dredge ready for operation about Sept. 1. Same date electric power line of Washington Water Power Co. will be completed.

AMBERGRIS (Wallace)—Crosscut from No. 4 tunnel of Hercules, near Burke, cut Ambergris vein at depth of 1000 ft. below shaft 200 ft. deep from surface. Vein shows ft. of good ore, lead-silver, and drifting started. In shaft is 2 to 3 ft. shipping ore, carrying silver. Hercules owns half of Ambergris through settlement of litigation years ago. Property lies along north side line of Hercules and ore struck in shaft near Hercules line. Will be developed through Hercules tunnel and ore transported to railroad over old Hercules tramway.

MICHIGAN

Copper

CALUMET AND HECLA (Calumet)—June production of C. & H. and its subsidiaries was: Ahmeek, 2,530,848; Allouez, 755,399; C. & H., 6,346,446; Centennial, 143,907; Isle Royale, 1,240,000; La Salle, 157,546; Osceola, 1,327,773; Superior, 193,050; Tamarack, 241,703; White Pine, 410,803.

SENECA (Calumet)—Will start sinking new shaft near Mohawk No. 2. Delays in delivery of material prevented rapid progress in preparatory work. Wagon road from county highway to mine is well advanced. Roadbed for spur of Keweenaw Central railway being constructed. Trying to have all equipment on ground before autumn.

Iron

CLEVELAND-CLIFFS (Ishpeming)—New hospital to be erected for miners of the Ishpeming district. Oliver company will assist with upkeep.

PRINCE OF WALES (Negaunee)—Oliver company suspended operations on June 30. Property taken over by Breitung interests. Ore in stock will be shipped within 30 days.

ROLLING MILL (Negaunee)—Closed down July 1. Large stock non-bessemer ore carrying sulphur on hand. Few sales made. Not desirable at this time. Jones & Laughlin Ore Co. has not one property working in Michigan at present time.

MINNESOTA

Mesabi Range

CARSON LAKE (Hibbing)—The General Contracting Co. of Chicago, erecting large concrete smokestack for new power plant being put in.

YORK MINE (Nashwauk)—Great Northern spur into property completed; will commence ore shipments to docks when washing plant is ready. Stanley Way, superintendent.

KEVIN AND PATRICK MINES (Nashwauk)—Great Northern enlarging ore yards preparatory for increased shipments when Butler Bros. get new concentrator working at these mines.

HANNA ORE CO. (Hibbing)—Have steam shovels cleaning up stock piles in Dale and So. Uno mines (open pits), and in large Harold and North Uno (underground). Stock piles left by Arthur Iron Mining Co. when leases were turned over to the Hanna people.

SCRANTON MINE (Hibbing)—Operated by Picands Mather Co., Robert Murray, superintendent, has purchased the Forty lying south for dump purposes, indicating mine will be opened up as open pit. Scranton originally opened up in 1917 as underground proposition but on account of large amounts of low-grade ore, mine was closed.

MISSOURI

Joplin District

BUFFALO (Quapaw, Okla.)—Installing machinery in new 200-ton mill. Mining at 165 ft.

FLANNERY (Sarcoxie) — To increase sludge department by additional 6 to 10 tables. Plant making 10 to 15 tons concentrate daily.

RAMAGE (Joplin)—Completed two new mills in Oklahoma field, one at Century and the other near Picher. Both plants capable of handling 400 tons per 10-hour shift of rich ore. Steam power. H. H. Hartzell, Joplin, manager.

SCOTT-EAGLE (Century, Okla.)—New 150-ton mill completed and placed in operation during week. Rich ground at 160 ft. Adam Scott, Joplin, one of principals.

PRAIRIE DOG (Quapaw, Okla.) — Moved New State mill from Commerce to new shaft, where rich ore found at 150 ft. S. D. Newton, Quapaw, manager.

J. T. WHALEY and associates, of Holdenville, Okla., purchased 40-acre lease adjoining Prairie Dog lease near Quapaw. Reported consideration, $20,000.

PARAMOUNT (Quapaw, Okla.)—Carrying on successful drilling campaign, having 12 good holes out of that many put down. Will start construction of mill soon. E. C. Naity, president.

BROWN & CO. (Joplin)—Started sinking 2 shafts on Renzenhausen farm southwest of Joplin; good ore found while drilling last Autumn. Is out of regular field, but fine ore run disclosed. Company known as Live Wire; H. E. Gerke, Joplin, principal.

EAST HAMPTON (Wentworth)—Planning to reopen ground. Ran tailings over big mill recently. Instead of using usual scraper to supply mill, 15 to 20 men employed to shovel tails into surface cars, and hoisted to mill hopper. Frank Waddell, superintendent. Mrs. Sarah Matlack, owner.

VINEGAR HILL (Baxter)—Getting rich ore from 150-ft. level for recently completed Barr mill, near Blue Mound, west of Baxter, Kan. Two other shafts being put down to 300 ft. On lease of 60 acres, 30 drill holes show cuttings averaging better than 10% blende and lead. Blue Mound mine, opposite, producing heavily for months. S. H. Davis, Baxter, manager.

MONTANA

Broadwater County

HYANTHA MINE (Winston)—Two car loads a week of silver-lead ore from 300-ft. level. C. S. Muffly, superintendent.

IRON MASK (Townsend)—Unwatering 350-ft. shaft. Complex lead-zinc ore. Extensive operations projected.

INDIAN CREEK PLACER (Townsend)—Taking up bedrock and lowering flume to correspond with gravel depth at head of open cut. Gravel 50 ft. deep. Hydraulic. J. H. Smith, manager.

Lewis and Clark County

STANTON MINE (Rimini)—Shipments lead-zinc ore being made. Worked by tunnel.

TRUE FRIEND (Helena)—New gasoline hoist in place. Shaft 150 ft. deep. Ore, low grade.

STEMWINDER MINE (Helena)—New steam hoist soon to be in place. Ore, high-grade silver. Deepening shaft.

PRODUCER MINE (Helena) — Two-stamp gold mill, crushing ore from tunnel. Low grade, large tonnage in sight.

HELENA MINE (Helena)—Ore shipments to smeltery from 300 level. Ore from one to three feet wide of silver-lead.

ROCK ROSE CO. (Helena) — Vertical shaft 300 ft. deep and drifting begun. Virgin ground from 100 to 300-ft. level. Good ore in drifts on 200 level.

SCRATCH GRAVEL GOLD (Helena)—Nearly $4000 to car load net smeltery returns received for ore shipments to East Helena smeltery. Ore stoped from 300-ft. level.

Silver Bow County

TOULUMNE (Butte)—Resumed operations at Toulumne mine and Main Range properties. Closed down during last month, account of strike. Now has full force on day shift and partial force on night shift; expect to have normal output in 10 days.

DAVIS-DALY (Butte)—Labor difficulties with electricians, blacksmiths, machinists, engineers and other crafts settled. Butte-Detroit mill completed to handle manganese ores; will rush work at Hibernia and new Republic mines in western district where manganese orebodies are opened. Expect to turn out concentrates by Aug. handling 200 to 400 tons per day from mines.

BARNES-KING DEVELOPMENT (Butte)—Company's statement for June production shows total amount gold bullion for all properties was $45,773, about $15,000 less than May because of labor shortage. The following productions were recorded: North Mocassin, 1424 tons, averaging about $8 per ton, totalling $11,341; Shannon mine, 2408 tons, averaging $13.69 per ton; Gloster, 1242 tons, averaging $6.65 per ton. Total amount ore treated at Piegan-Gloster mill was 3767 tons, value of bullion produced, $34,432. Good ore struck on 500 level of Shannon, 30 samples showed average assay of $76.60 per ton. Payment of $15,480 made on Shannon title from June proceeds, unpaid balance is $61,442.

NEVADA

Esmeralda County

TONOPAH ORE PRODUCTION for week ended July 14 was 8902 tons, valued at $160,238, comparing with 6923 tons for previous week. Producers were: Tonopah Belmont, 2532 tons; Tonopah Mining, 2100 tons; Tonopah Extension, 2380 tons; Jim Butler, 700 tons; West End, 895 tons; Rescue, 187 tons; Montana, 108 tons.

Nye County

WHITE CAPS EXTENSION (Manhattan) — Jackhamer drills being used in sinking 3-compartment vertical shaft; ground is a soft shale. Shaft now sunk 28 ft. and three sets of timbers in place.

MANHATTAN-MUSTANG MINING CO. (Manhattan)—New orebody exposed on the Mustang, about 150 ft. south from the Train, Chase Lease workings. Cross fissure running north and south in the schist has been developed from surface which shows good assays in gold across 2 ft.

Storey County

ALPHA (Gold Hill)—North drift in 200 level started and advanced 8 ft., total 176 ft., toward Exchequer. Face in soft quartz.

OPHIR (Virginia)—Old drifts on 2000 and 2700 levels reopened, work continued to total of 268 ft. on 2000, and 656 ft. on the 2700.

SIERRA NEVADA (Virginia) — Old north drift 2506 level cleaned out and repaired 12 ft., making total distance 895 ft.; timbered 17 ft., making total 100 ft.

MEXICAN (Virginia) — On 2900 level continued reopening main lateral drift; total distance repaired 346 ft. Air connection made at this point with M. & O. winze.

UNION CON. (Virginia)—Opening of 2700 level completed on July 15 and mining begun on this level on July 16 for first time in 34 yr. Extracted 70 tons of ore from 2300 level, car samples averaging $12.95 per ton.

YELLOW JACKET (Gold Hill)—Repairs to shaft continued. Sent 500 tons of ore to gloryhole from shaft bins. Saved 140 cars from workings; 429 cars drawn from chutes. Mill repairs completed and ready to resume operation July 19.

CON. VIRGINIA (Virginia)—Drift following hanging wall of vein on 2700 level advanced 5 ft., making total of 137 ft. The 2-compartment winze started in ore below sill floor of stope sunk 7 ft. From opening extracted 58 cars of ore assaying $25.61 per ton; 7 cars from second floor assaying $11.60 per ton; 17 cars of ore sent to gloryhole.

UTAH

Beaver County

MAJESTIC (Milford)—Fifteen cars low grade copper ore shipped during June from Old Hickory. Hoosier Boy being developed chiefly on 700 level. Ore is lead-silver.

Juab County

CHIEF CONSOLIDATED (Eureka)—June shipments were 130 cars, estimated at 6500 tons. First 6 months of 1917, output 828 cars, estimated at 40,000 tons.

IRON BLOSSOM (Silver City)—Reported net earnings for June, $31,000; shipped 130 cars. Much ore being shipped to Tintic Milling plant. Total output for first six months 1917, was 761 cars or about 35,000 tons.

Salt Lake County

KENNEBECK (Salt Lake)—Work to be resumed at old mine in Big Cottonwood; air to be furnished by the Cardiff.

CARDIFF (Salt Lake)—This Big Cottonwood property stated to be shipping up to 100 tons daily. Shipments hindered by haulage difficulties.

UTAH COPPER (Bingham)—Estimated June output will exceed May, which amounted to 19,262,856 lb. Treating 35,000 to 38,000 tons daily at milling plants; extraction averaging 1.5% copper.

OHIO COPPER (Bingham) — Treating ores by flotation and expect to erect larger plant. Stated mine has 640,000 tons of ore ready for extraction, and calculated there are 20,000,000 tons of ore averaging over 0.75% copper, which can be treated.

BINGHAM AMALGAMATED (Bingham)—Water coming into workings from surface during recent flood, now 20 ft. below collar of inclined shaft; work will be resumed when this is 300 ft. below. Two cars copper ore shipped recently from 300 level. Shaft down 600 ft.

Tooele County

GARRISON MONSTER (Gold Hill)—This Deep Creek property has 11 men working and force to be increased. Said to be 20 cars of lead-silver ore on dump.

WISCONSIN

Zinc-Lead District

VINEGAR HILL (Platteville)—Resumed construction of new two-jig mill at Jefferson mine, at Hazel Green.

WISCONSIN ZINC CO. (Platteville)—New two-jig mill is under construction on the Copeland lease near Shullsburg.

DICKINSON (Platteville)—E. R. Brown and others have taken over this prospect and will complete shaft to the 85-ft. level, where lead ore was found by churn drill.

G. O. P. (Platteville)—M. B. Huntley and Milwaukee men have purchased this mine, on the old Raisbeck range at Cuba City; the Roosevelt mill has been bought by them and will be moved to the mine.

NEW SURVEY (Dodgeville)—Made first shipment of zinc concentrates to the Mineral Point Zinc Co.

CANADA

Ontario

HUDSON BAY (Cobalt)—In June produced 28,000 oz. of silver.

CHARETTE CLAIMS (Boston Creek)—Vein varying in width from 2 in. to 4 ft. uncovered carrying free gold in places.

NATIONAL POTASH CORPORATION (Gravenhurst)—Erecting plant capable producing about 36 tons potash per day.

DOME LAKE (Porcupine)—In winze below 400-ft. level, ore shoot about 7 ft. wide carrying $9 to ton in gold opened for 50 ft.

CHAMBERS FERLAND (Cobalt)—Digging sewer on property workmen encountered vein carrying cobalt, niccolite and some silver.

DOMINION MOLYBDENITE (Wilberforce)—Orebody of favorable size proved up, and management has decided to erect mill.

ELLIOTT-KIRKLAND (Kirkland Lake)—Heavy flow from water seam encountered at 165 ft., caused suspension of work pending installation of steam equipment.

PETERSON LAKE (Cobalt)—Vein on Susquehanna leasehold after narrowing to 1 in. has faulted, and further exploration abandoned. Another vein being opened up.

GENESSEE (Cobalt)—Main shaft now down 465 ft.; ruby silver showing in narrow vein. When 500-ft. level reached, will crosscut to pick up veins coming in from Chambers-Ferland.

BUFFALO (Cobalt)—Purchased group of 13 claims in McElroy township directly east of Boston Gold Leaf and have started work. Development on Brisboise and Mondean properties, two of those acquired, reported to have exposed some exceptionally promising veins.

TECK HUGHES (Kirkland Lake)—Decided to sink from present level of 400 ft. on No. 1 vein to 600 ft. Veins found on surface persist to 400-ft. level; lateral work will be done at 600-ft. level. During June mill heads ran $9.66, but tonnage treated was low owing to labor shortage.

LAKE SHORE (Kirkland Lake)—Workings will be continued downwards to 400-ft. point, where crosscut will be driven under the lake to cut high-grade vein on 200-ft. level, after tapping which raise will be made to upper level. Most of machinery for mill now on ground.

MEXICO

GREENE CANANEA (Cananea, Son.)—Production of copper for first 22 days of June was 3,210,000 lb. Mines closed on June 22, on account Mexican troubles.

CHILE

CHILE COPPER CO. (Chuquicamata)—June copper output was 6,114,000 lb.

BELGIAN CONGO

UNION MINIERE DU HAUT KATANGA (Elizabethville)—June production of copper was 5,246,948 lb., comparing with 5,643,775 lb. for May.

PERU

CERRO DE PASCO (La Fundicion)—June production 5,032,000 lb. copper, comparing with 4,670,000 lb. for May.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—May bullion amounted to $115,330 divided as follows: Tabowie mill, $24,598; Taracal, $24,137; Maibong, $18,439; Taracal cyanide plant, $44,283; Maibong tube mill plant, $3872. Messrs. Okura & Co.'s electric power plant shut down for repairs several times during month caused 22 hr. loss to company. Company's own hydro-electric plant ran without stoppage. Reported leader and another of 9 bandits who attacked returning bullion train on Oct. 6 last captured by police.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

July	Sterling Exchange	Silver New York, Cents	Silver London, Pence	July	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
19	4.7550	79⅛	40⅛	23	4.7550	78⅛	39⅝
20	4.7550	78⅛	39 11/16	24	4.7550	78⅛	39⅝
21	4.7550	78⅛	39 11/16	25	4.7556	78⅛	39⅝

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

July	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	24		10	10¼	8
19	@25	62¼	@11	@10¼	@8¼
	24		10	10¼	8
20	@25	62¼	@10¼	@10¼	@8¼
	24		10	10	8¼
21	@25	62¼	@10¼	@10¼	@8¼
	24		10	10	8¼
23	@25	62¼	@10¼	@10¼	@8¼
	24		10	10	8¼
24	@25	62¼	@10¼	@10¼	@8¼
	24		10	10	8¼
25	@25	62¼	@10¼	@10¼	@8¼

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes; ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

July	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
19	130	129½	142	239	235½	30½	54
20	130	129½	142	240	236½	30½	54
21	...	...	...	...	...	...	...
23	125	124½	137	239	236½	30½	54
24	125	124½	137	238½	236	30½	54
25	125	124½	137	239½	236½	30½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £5 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

NEW YORK—July 25, 1917

Lead was a little softer than in the previous week and zinc was a little stronger. Copper was steadier in tone.

Copper, Tin, Lead and Zinc

Copper—This market was in a good deal of confusion, there being reports of very low offers, down to 23c., regular terms, for the fourth quarter, and lower still for delivery in the first quarter of 1918. The facts of the situation, so far as we could determine them, are that at the low point reached at the close of last week the market seemed to have found bottom, some buying interest being developed; discerning which, the interests that had previously been offering copper down withdrew their pressure. Lower offers continued to be made by second-hands, either in behalf of speculative holdings or of consumers who desired to resell, but in general the quantities that they had to offer were trifling and buyers who wanted to take round lots found themselves obliged to pay higher prices and did so. There was distinctively more inquiry, but this did not result in much business, although several lots of half-million and million pound size were turned over. The premium on near-by copper has now all but disappeared and it makes no great difference whether anybody wants to buy July, or August, or August-December.

Advices from Butte this morning, as reported elsewhere in this issue, were to the effect that the companies had made to the striking miners a proposition that has fair chances of acceptance. Reports from Arizona indicate an improvement in the situation at Bisbee, Globe and Morenci. However, the check to production during July is a serious matter. All of the refiners have been eating into their stock of blister copper, while at Great Falls the stock has been exhausted and that refinery, which has a normal production of 20,000,000 lb. of refined copper monthly, is closing down.

Copper Sheets are quoted at 37@38c. per lb. for hot rolled, and 1c. higher for cold rolled. Wire is quoted at 33c. per lb., f.o.b. mill.

Tin—There was very little business and very little inquiry. Total transactions were probably less than 300 tons. Changes in price were but trifling. Banka tin, however, was relatively weak, the discount from the price for Straits tin rising to about 3¾c. per pound.

Lead—Our intimation last week, that producers would meet the lower prices, if they could get business, was borne out, and certain of them accepted prices around 10¼c. for round lots, prompt delivery, while there were sellers of September-October lead at 10c. At the close, however, persons who had purchased at 10@10¼c., were reported as saying that they could not obtain additional supplies at less than 10¼c., though probably they might have done so if they had tried all quarters.

The labor situation in southeastern Missouri is about in statu quo. Production of pig lead has not yet been affected, there having been sufficient stocks of ore to keep the furnaces going, although the production of ore by the mines has been reduced about 50%. However, it is estimated that even if the labor difficulties be ended right away, there will be inevitably som falling off in pig lad production in August.

Zinc—On July 19, there were transactions at 8c. and later at 8¼@8.15c., the bulk of the business being around the latter figures. During the remainder of the week, a fair volume of business was done, partly with speculators and partly with consumers at a slight advance in price.

On July 25, the Zinc Committee reported that the following transactions had been consummated with the Ordnance Bureau of the War Department: 8,250,000 lb. of Grade A spelter at 13¼c.; 15,000,000 lb. of Grade B at 13c.; delivery to be made in approximately equal quantities monthly during the next 10 months. This is the same transaction that was previously reported, but has been hanging fire during several weeks. In order that confusion may be avoided, it should be noted that this is the second transaction that the Zinc Committee has made with the Government, the first having been in April last. There is no truth in the rumor circulating today to the effect that the Government is negotiating for 25,000 tons of Grade C (prime western) spelter.

Zinc Sheets—Price of zinc sheets has not been changed. Market is still at $19 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

Other Metals

Aluminum—The aluminum market continues extremely quiet. Quotations are about as noted last week, quick delivery being offered at 55@57c. per lb. for No. 1 ingots at New York; futures slightly lower.

Antimony—This market is very dull. Quotations here are lower than in China, this situation being the result of speculative buying that was entered into with the expectation that a rise in the market would happen at about this time, owing to Government buying. Such buying not having materialized, speculative holders have been realizing. We quote 14½@15c. for spot, which is a decline of more than a cent from the previous week. The price for futures is uncertain, producers not quoting. We quote August shipments from China, nominally, at 14@14½c., c.i.f., in bond.

Bismuth—Quoted at $3.50 per lb.

Cadmium—Quoted at $1.45@1.75 per lb.

Cobalt—Quoted at $1.70 per lb.

Nickel—Steady at 50@55c. per lb., with premium of 5c. per lb. for electrolytic.

Quicksilver—The market is somewhat stronger than reported last week. The stocks in New York continue light, and quotations are made here at $115. San Francisco reports by telegraph $105, strong.

Gold, Silver and Platinum

Gold—Coin amounting to a considerable sum has been withdrawn from the New York subtreasury for shipment to Spain. Additional withdrawals during the week were $200,000 for shipment to Canada and $20,000 more for Spain.

The Indian Government has prohibited the import of gold into India except by special license. It has also strictly forbidden the melting of gold coins for any purpose whatever.

Silver—The silver market has had a sagging tendency the past week, falling from 40⅜ pence in London on the 19th to 39⅜ pence on the 25th, and closing steady at that price. The prohibition of imports of silver into India, except on Government account, has had a tendency to lessen the demand for shipments to India. The stock of silver held by the Indian Treasury has recently shown a substantial increase.

A compilation by the National City Bank, of New York, shows that the United States is now the world's premier silver producer, its output being double that of Mexico and three times that of Canada.

The Indian Government has increased its holdings of silver coin lately and on July 10 had in the treasury reserve 202,400,000 rupees. Silver stocks in Bombay have increased and at latest date were 2300 bars. Stocks in Shanghai have also increased and are reported at 14,800,000 in dollars and 20,900,000 oz. sycee.

Mexican dollars at New York: July 18, 63c.; 19, 62½c.; 20, 62½c.; 21, 61½c.; 23, 61½c.; 24, 61½c.

Platinum—Market quiet and steady at $105.

Palladium—Firm at $115. One producer reports having had to decline an offer at that price, owing to not having the metal.

Zinc and Lead Ore Markets

Platteville, Wis., July 21—Blende, 60% Zn, $70 for premium ore down to $65 for medium grade. Lead ore, basis 80% Pb, $120 per ton. Shipments reported for the week are 2676 tons of zinc ore, 199 tons of lead ore, and 569 tons of sulphur ore. For the year to date the figures are: 77,964 tons of zinc ore, 3725 tons of lead ore, and 16,352 tons of sulphur ore. Shipped during the week to separating plants, 3604 tons of zinc ore.

Joplin, Mo., July 21—Blende, per ton, high $77.80; basis 60% Zn, premium $75, medium to low, $70@65; calamine per ton, basis 40% Zn, $42@40; average selling price, all grades of zinc, $68.10 per ton.

Lead, high $128.50; basis 80% Pb, $125@115; average selling price, all grades of lead, $123.29 per ton.

Shipments the week: Blende, 9845 tons, calamine, 572 tons, lead, 2152 tons. Value all ores the week, $974,950. Following two quiet weeks, the past fortnight has shown a resumption toward heavier shipping. Prices, however, continue to show an average decline, and for two weeks a drop of $5 in base price has been expected by local buyers. There is no question but that

the Oklahoma field can produce cheap ore, and large quantities of it, but whether they will or not remains to be seen. It is said the bulk of the large producing mines are owned by Oklahoma oil capitalists who can hold their ore or shut down at will. They are mining, some assert, for the sport of it and to make all the money they can out of it.

Other Ores

Antimony Ore—Nothing reported done.

Chrome Ore — Unchanged. Considerable business was done at $1 per unit, f.o.b. California, for ore of 45 to 46% chromic oxide.

Manganese Ore—Market seems willing to absorb all the high grade metallurgical ore that is offered at $1.20 per unit. Chemical ore is quoted at 5@7c. per lb., according to grade.

Molybdenum Ore—Unchanged at $2.10@2.25 per lb. of molybdenum sulphide in concentrates assaying 90%. Whatever ore comes into the market finds ready sale.

Iron Ore—Prices, delivered lower Lake ports are for old-range bessemer, $5.95; old-range nonbessemer, $5.20; Mesabi bessemer, $5.70 and Mesabi nonbessemer, $5.05.

Pyrites—Spanish lump quoted at 15½c. per unit on basis of 10s. ocean freight, buyer to pay war risk, excess freight and any duty. Ocean freights are 42s. 6d. from Huelva to southern ports, contracts having been made at that figure lately.

Tungsten Ore—Market strong. The best grade of wolframite on the spot in New York sold at $25 per unit; scheelite at $26.

Iron Trade Review

NEW YORK—July 25

Buyers of pig iron and of all forms of finished steel continue for the most part to hold aloof from the market, says "Iron Age," and their fear of what may happen to prices as the result of Government action is in sharp contrast with their willingness only lately to pay any price the producer might name.

PITTSBURGH—July 24

The volume of transactions in pig iron, unfinished steel and finished steel has dropped to almost nothing. In pig iron, purchases are confined to small lots for early delivery. In steel products there is little demand, and this little is confined to early deliveries which the mills can scarcely compass. Specifications on current contracts, which are chiefly at prices much lower than those now quoted as representing the market, have undergone a further decrease.

The large steel interests are making no effort to book business and seem to welcome the clearing of order books which is in progress. While the Steel Corporation's unfilled obligations decreased 500,000 tons in June estimates of the July decrease run up to 750,000 tons.

Production is curtailed by hot weather, as is usual in July and August, and coke continues scarce. While car supplies in the Connellsville coke region are much better the operators now complain of labor shortage.

There is no expectation that the present stagnation in the pig iron and steel markets will yield to really active conditions until there is a general readjustment downwards in prices. Some think this will start when prices are fixed for Government requirements, upon the Federal Trade Commission making its report as to present cost of production, a report expected a fortnight hence. Others think nothing of importance will ccur until order books become relatively clear, some months hence. The pressure for deliveries of steel is keen, but reduced consumption is in prospect, particularly in the building trades and in railroad work.

Pig Iron—The market has been stagnant, transactions being confined to small lots for early delivery, and some resale iron has figured, particularly in the case of bessemer, at cut prices. Minimum prices on bessemer and basic are quotable $1 a ton lower than formerly. We now quote: Bessemer, $55@57; basic, $53@55; foundry and malleable, $53@56, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Steel—There have been no important transactions. Sellers are calling for heavier specifications on contracts, suggesting an easier position, and an authority expresses the opinion that billets forced on the market would not bring over $80. Former quotations, based on sales, were $95@100 for billets and $105@110 for sheet bars.

STOCK QUOTATIONS

N. Y. EXCH.†	July 24
Alaska Gold M	5½
Alaska Juneau	4
Am.Sm.& Ref.,com.	101½
Am. Sm. & Ref., pf.	113
Am. Sm. Sec., pf., A	99½
Am. Sm. Sec., pf. B	92½
Am. Zinc	24¼
Am. Zinc, pf	62
Anaconda	76½
Batopilas Min	1½
Bethlehem Steel	130
Bethlehem Steel, pf.	115½
Butte & Superior	36½
Cerro de Pasco	34¼
Chile Cop	19½
Chino	53½
Colo.Fuel & Iron	48½
Crucible Steel	79½
Dome Mines	10½
Federal M. & S.	14
Federal M. & S., pf.	44½
Great Nor., ore ctf.	33
Greene Cananea	41½
Gulf States Steel	115
Homestake	100½
Inspiration Con	54¼
International Nickel	38½
Kennecott	42½
Lackawanna Steel	91
Miami Copper	40
Nat'l Lead, com	55
National Lead, pf.	110
Nev. Consol	22
Ontario Min	5½
Quicksilver	1½
Quicksilver, pf.	1½
Ray Con	26½
Republic I.&S.,com.	89½
Republic I. & S., pf.	102½
Sloss-Sheffield	52
Tennessee C. & C.	17½
U. S. Steel, com	120½
U. S. Steel, pf	117½
Utah Copper	102½
Va. Iron C. & C.	67

N. Y. CURB†	July 24
Big Ledge	1½
Butte & N. Y.	1½
Butte C. & Z	9
Caledonia	.70
Calumet & Jerome	1 3/16
Can. Cop. Corpn	2 1/16
Carlisle	4
Cashboy	.06½
Con. Ariz. Sm.	2 3/16
Con. Coppermines	7½
Con. Nev.-Utah	1/16
Emma Con	1/16
Ferber	‡.60
First Nat. Cop.	2½
Goldfield Con	.52
Goldfield Merger	.05
Greenmonster	1/16
Hecla Min	8 1/16
Howe Sound	5½
Jerome Verde	1½
Kerr Lake	5
Magma	49
Majestic	42
McKinley-Dar-Sa	.53
Mohican	.75
Mother Lode	27
N. Y. & Hond	12½
Nipissing Mines	7½
Ohio Cop	1 3/16
Ray Hercules	3½
Richmond	.57
Rochester Mines	.48
St. Joseph Lead	20
Standard S. L.	1/16
Stewart	1/16
Success	.29
Tonopah	6½
Tonopah Ex	2 3/16
Tribullion	.25
Troy Arizona	.22
United Cop	.75
United Verde Ext	.36
United Zinc	.4¼
Utica Mines	.22
White Knob, pf.	1½
White Oaks	‡2
Yukon Gold	1½

SAN FRAN.*	July 24
Alta	.04
Andes	.13
Best & Belcher	.02
Bullion	.01
Caledonia	.19
Challenge Con	.01
Confidence	.05
Con. Virginia	.24
Gould & Curry	.02
Hale & Norcross	.03
Jacket-Cr. Pt	.06
Mexican	.08
Occidental	.65
Ophir	.09
Overman	‡.02
Savage	.05
Seg Belcher	.01
Sierra Nevada	.10
Union Con	.09
Utah Con	.01
Belmont	4.25
Jim Butler	.70
MacNamara	.16
Midway	.09
Mont.-Tonopah	.19
North Star	.10
Rescue Eula	.21
West End Con	.65
Atlanta	.09
Booth	.07
Comb. Frac	.04
D'field Daisy	.03
Florence	.16
Jumbo Extension	.26
Kewanas	.12
Nevada Hills	.21
Nevada Packard	.34
Round Mountain	.31
Silver Pick	.10
White Caps	1.25
Big Jim	.65
United Eastern	4.00

BOSTON EXCH.*	July 24
Adventure	2½
Ahmeek	98½
Algomah	.75
Alloues	61
Ariz. Com., ctfs.	12½
Arnold	.25
Bonanza	.20
Butte-Balaklava	.60
Calumet & Aris	.76
Calumet & Hecla	533
Centennial	17
Copper Range	58
Daly West	1½
Davis-Daly	5
East Butte	10½
Franklin	6
Granby	76
Hancock	14
Hedley	16
Helvetia	.35
Indiana	2
Isle Royale	30
Keweenaw	2½
Lake	11
La Salle	3½
Mason Valley	6½
Mass	13
Mayflower	2
Michigan	2½
Mohawk	80½
New Arcadian	3½
New Idria	‡14
North Butte	17½
North Lake	1
Ojibway	1½
Old Dominion	55
Osceola	83
Quincy	84
St. Mary's M. L.	76
Santa Fe	1
Seneca Mines	10
Shannon	7½
Shattuck-Aris	24
So. Lake	3½
So. Utah	.15
Superior	8½
Superior & Bost	4
Trinity	6½
Tuolumne	1
U. S. Smelting	56½
U. S. Smelt'g, pf.	49½
Utah Apex	2½
Utah Con	15
Utah Metal	4½
Victoria	3½
Winona	2½
Wolverine	44½
Wyandot	.45

BOSTON CURB*	July 24
Alaska Mines Corp.	.62
Bingham Mines	12½
Boston Ely	.40
Boston & Mont	.63
Butte & Lon'n Dev	.14
Calaveras	3
Calumet-Corbin	.01
Chief Con	2½
Cortez	.20
Crown Reserve	.27
Crystal Cop	1 3/16
Eagle & Blue Bell	.02½
Houghton Copper	.75
Intermountain	1½
Iron Cap, Com	.15½
Iron Cap Cop., pf.	.15½
Mexican Metals	.28
Mines of America	1½
Mojave Tungsten	.61
Nat. Zinc & Lead	.55
Nevada-Douglas	1
New Baltic	1½
New Cornelia	17½
Oneco	.50
Pacific Mines	.30
Rex Cons	.25

SALT LAKE*	July 21
Bannack	1.00
Big Four	.27½
Black Jack	.06
Cardiff	6.75
Colorado Mining	.20
Daly-Judge	8.00
Empire Copper	1.25
Gold Chain	.18
Grand Central	.60
Grand Gulch	.10
Iron Blossom	.87
Lower Mammoth	.03
May Day	.05½
Moscow	.12
Prince Con	1.07½
Silver-King Coal'n	2.97½
Silver King Con	3.75
Sioux Con	.10
So. Hecla	1.42
Uncle Sam	.02½
Wilbert	.22
Yankee	.07½

TORONTO*	July 24
Bailey	‡.03
Beaver Con	.33
Buffalo Mines	1.25
Chambers Ferland	.13½
Coniagas	3.75
La Rose	.47
Peterson Lake	.12
Right of Way	.05
T. & Hudson Bay	‡38.00
Temiskaming	.32½
Wettlaufer-Lor	.05½
Dome Exten	.16
Dome Lake	.18
Foley O'Brien	.60
Hollinger	4.50
McIntyre	1.53
Newray	.60
Porcu. Crown	.48
Schumacher	.42
Teck-Hughes	.48
Vipond	.30
West Dome	.19

STOCK QUOTATIONS—Continued

COLO. SPRINGS	July 24
Cresson Con	5.93½
Doctor Jack Pot	.04½
Elkton Con	.06
El Paso	.29
Gold Sovereign	.04½
Golden Cycle	2.14½
Granite	.50
Isabella	.10
Mary McKinney	.16
Portland	1.45
United Gold M	.22½
Vindicator	.70

LONDON	July 12		
	£0	10s	0d
Alaska Mexican	0	16	0
Alaska Tre'dwell	1	0	0
Burma Corp	4	3	9
Cam & Motor	0	7	9
Camp Bird	0	6	6
El Oro	0	10	0
Esperanza	0	9	6
Mexican Mines	4	7	6
Nechi, pfd	0	12	6
Oroville	0	16	3
Santa Gert'dis	0	10	6
Tomboy	0	18	6

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755	77.585	22.753	26.975	37.742
March	50.241	57.935	73.861	23.708	27.597	36.410
April	50.250	64.415	73.875	23.709	30.662	36.963
May	49.915	74.269	74.745	23.570	35.477	37.940
June	49.034	65.024	76.971	23.267	31.060	39.065
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.765		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0 925 fine

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan	24.008	28.673	88.083	131.921	116.167	142.895
Feb	26.440	31.750	102.667	137.895	133.167	148.100
Mar	26.310	31.481	107.714	136.750	136.000	151.000
April	27.895	27.935	124.319	133.842	137.389	147.158
May	28.625	28.788	135.457	130.000	152.522	142.000
June	26.601	29.962	112.432	130.000	137.455	142.000
July	23.865		95.119		125.500	
Aug	26.120		110.283		126.304	
Sept	26.855		113.905		134.071	
Oct	27.193		122.750		142.523	
Nov	30.625		134.659		155.432	
Dec	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717	51.420	181.107	198.974
March	50.741	54.388	193.609	207.443
April	51.230	55.910	199.736	220.171
May	49.125	63.173	196.511	245.114
June	42.231	62.053	179.466	242.083
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av year	43.480		182.096	

Lead	New York		St Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246	8.636	6.164	8.595	31.988	30.500
March	7.136	9.199	7.373	9.120	34.440	30.500
April	7.630	9.288	7.655	9.158	34.368	30.500
May	7.463	10.207	7.332	10.202	32.967	30.500
June	6.936	11.171	6.749	11 123	31.011	30.500
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.853		6.777		31.359	

Spelter	New York		St Louis		London	
	1916	1917	1916	1917	1916	1917
Jan	16.915	9.619	16.745	9.449	89.810	48.329
Feb	18.420	10.045	18.260	9.875	97.762	47.000
Mar	16.846	10.300	16.676	10.130	95.048	47.000
April	16.695	9.459	16.525	9.289	99.056	54.632
May	14.276	9.362	14.106	9.192	94.217	54.000
June	11.752	9.371	11.582	9.201	68.591	54.000
July	8.925		8.755		50.750	
Aug	8.730		8.560		51.587	
Sept	8.990		8.820		52.095	
Oct	9.829		9.659		54.159	
Nov	11.592		11.422		56.023	
Dec	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ‡ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1916	1917	1916	1917
January	$21.60	$35.95	$18.78	$30.95	$19.70	$30.95
February	21.16	36.37	18.93	30.95	19.51	30.95
March	21.81	37.37	19.20	33.49	19.45	35.91
April	21.65	42.23	18.95	38.90	19.45	40.06
May	21.78	46.94	19.11	42.84	19.58	43.60
June	21.95	54.22	18.95	50.05	19.34	50.14
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.